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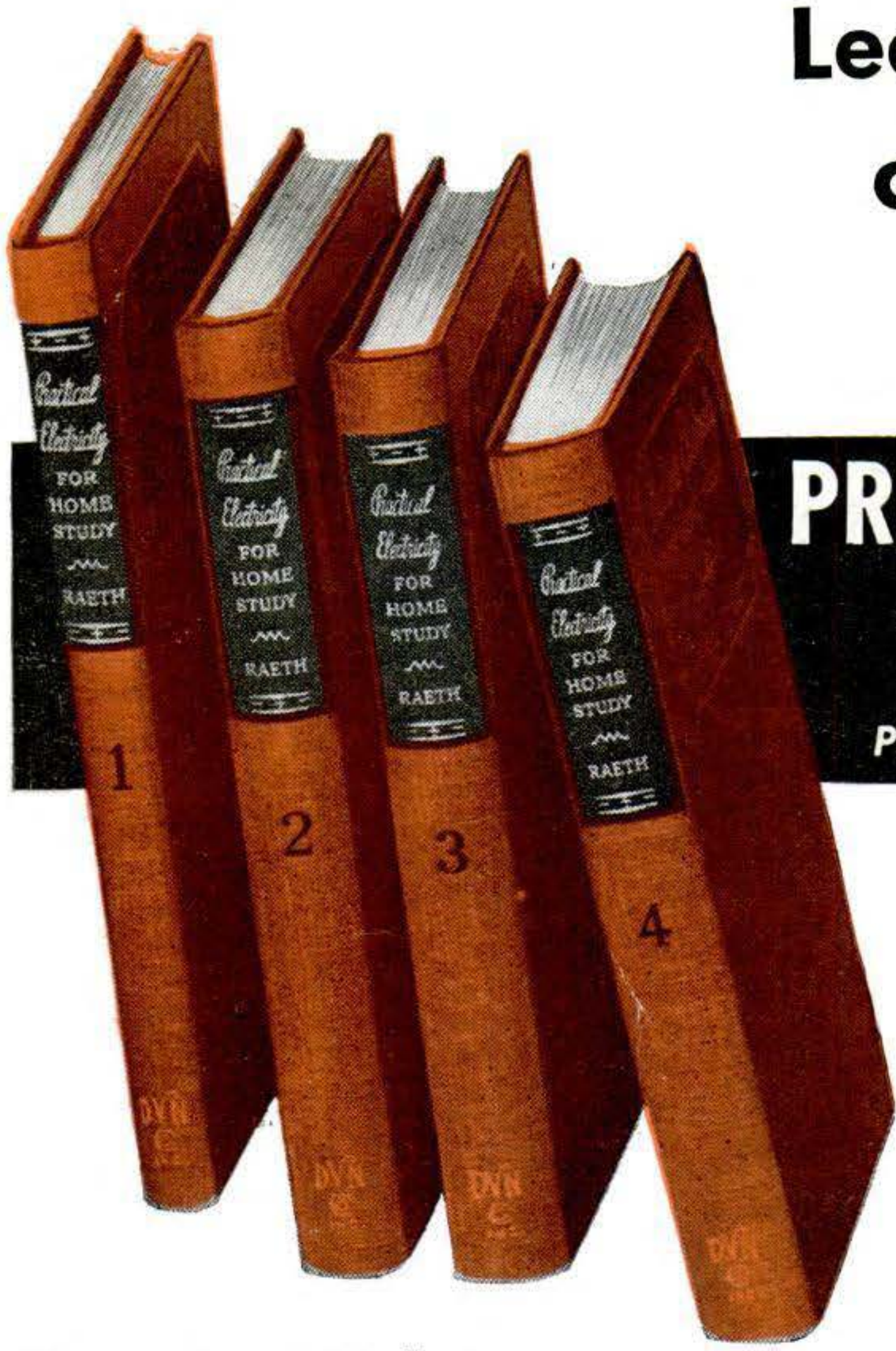

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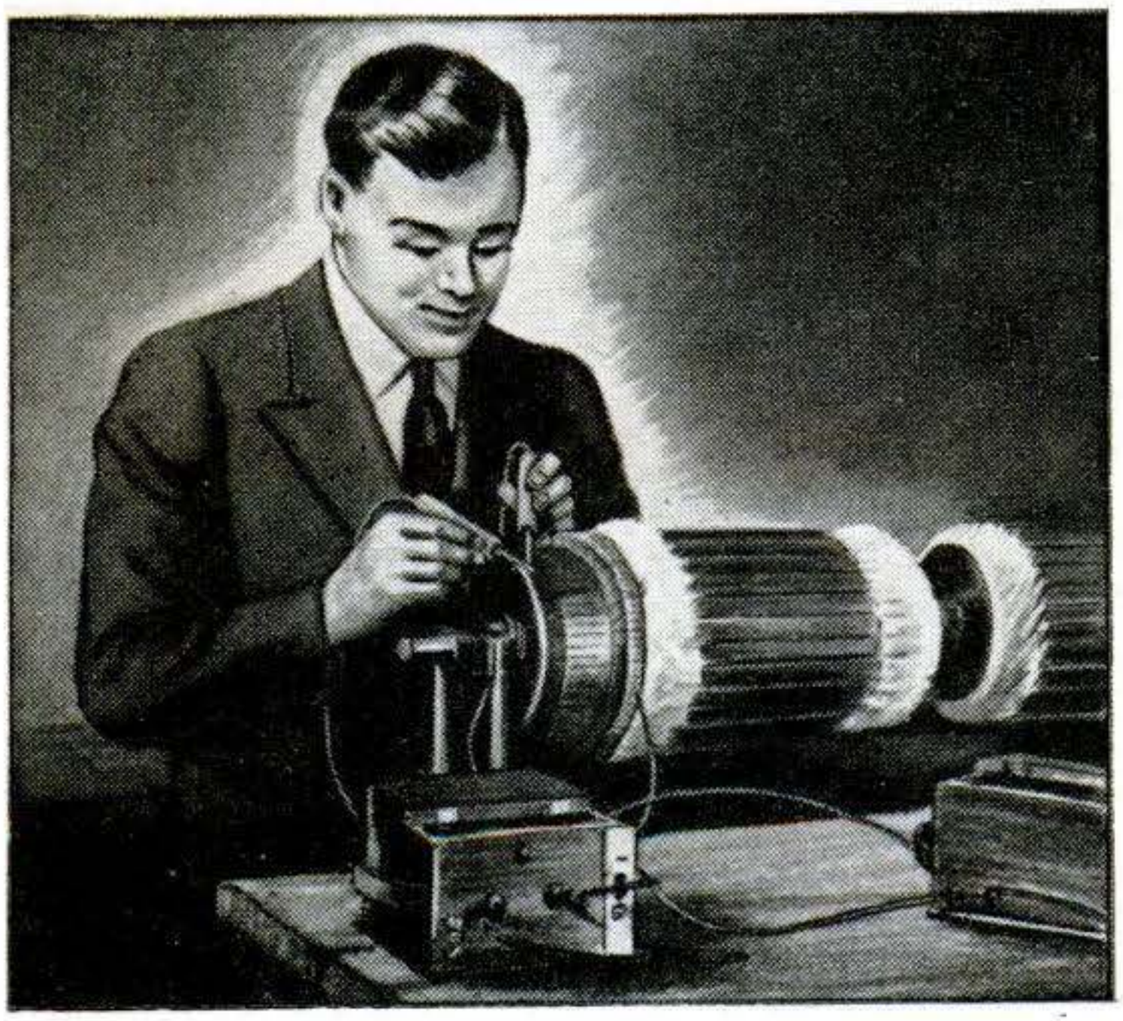

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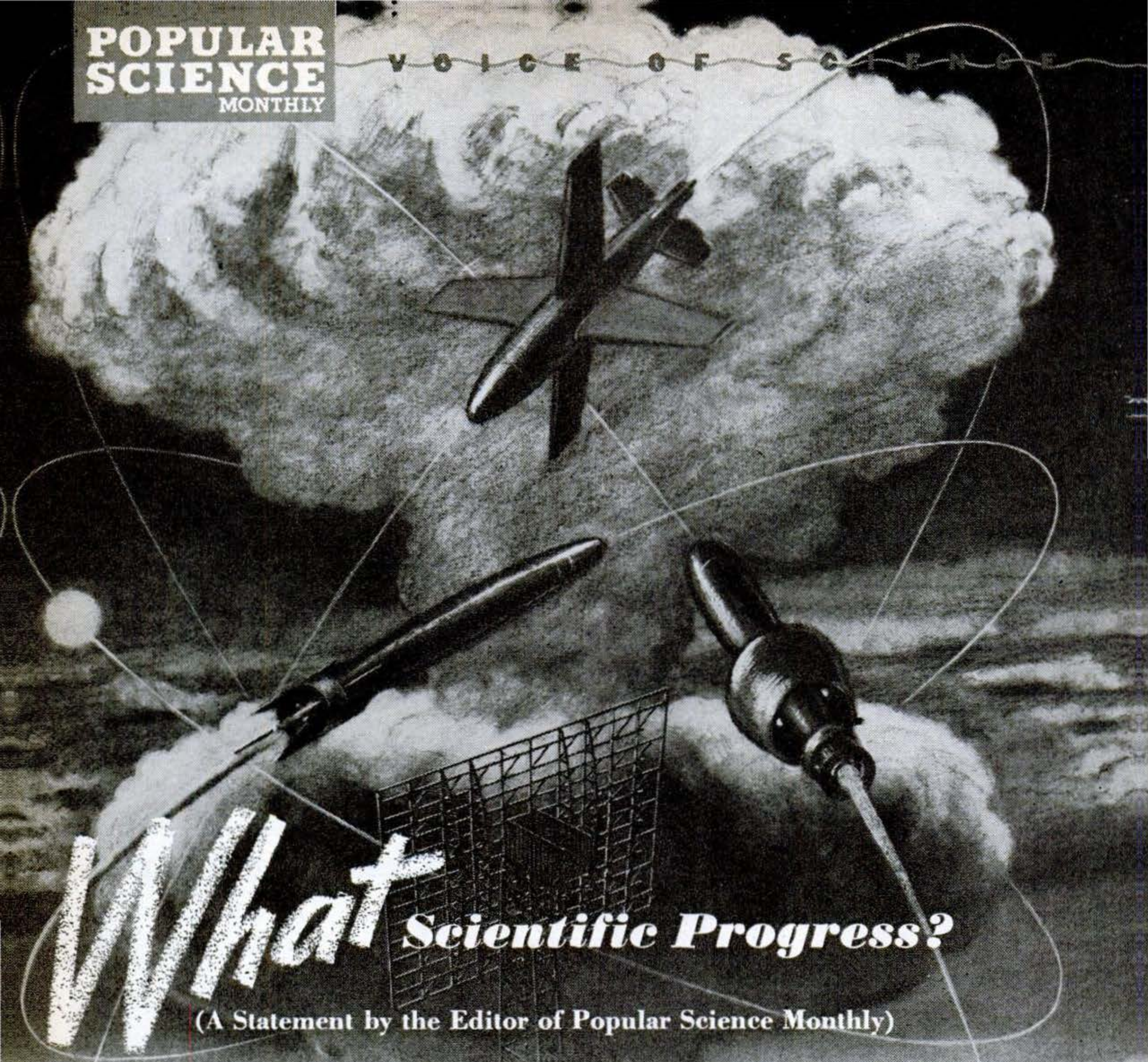

What Scientific Progress?

(A Statement by the Editor of Popular Science Monthly)

THERE is a smug and satisfied feeling, despite the awesome implications of the A-bomb, that we made great scientific strides during the war. That atom-smashing was certainly something, wasn't it? And don't forget radar, loran, guided missiles, the proximity fuse, and all the other devil's gadgets that have been hitting the headlines.

The ugly truth is that *we made almost no scientific progress in the war years.* Of course, we made tremendous gains in engineering. In making the A-bomb, the work done on pumps alone, for example, would have taken a couple of centuries of peacetime plugging. And great things are coming in medicine as a direct application of nuclear fission.

But radar and the rest—even the A-bomb itself—were really applications of pure scientific research, discovery, and development done years or decades ago. That kind of research—fundamental science—stopped dead during the war; in any struggle for survival there is no time for big thinking.

Now, the war is over; but peace—the flowering time of science—has not yet begun. These are blank days in the calendar of pure research. Nuclear physicists are unemployed: cyclotrons are still locked up in military security. In every field that touches wartime technology, scientists are standing around like carpenters without hammers.

This would not be so bad except that true science knows neither country, nor clock, nor calendar. A blank spot in fundamental research now means a blank spot in applied science a year or a decade from now, a dead time sometime in the engineering that puts science to work for all of us. For you can't have applied science without science.—PERRY GITHENS

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This was a bitter blow to George—he had known for some time there would be a vacancy in his department—the department manager was moving up—a new department head would be appointed. By seniority George was entitled to the job, had been counting on it.

It would mean more money—those unpaid bills would be taken care of—the children would have more advantages—there would be travel, recreation, social activities.

George had been a fine, loyal employee for twelve years—doing his assigned tasks well—hoping by faithful service to win some day an executive position with his company.

Now all of these hopes were being swept away—as in a dream he heard his chief continue—"You see, George, in these days it is ability to produce that counts. You're not ready to take on the bigger job—you have made no preparations which would enable you to fill it properly. The man who is going to get that job is Martin. He has been with us only four years, but during that time he has not only been studying the relationship of his department to the business as a whole, but he has been studying and preparing himself at home."

Poor George—no one to blame but himself. Business is full of "Georges"—men who do not realize the importance of preparing definitely for promotion. They forget that long experience on one job does not necessarily prepare them for the job above. And almost never do they reach the executive job and the bigger money.

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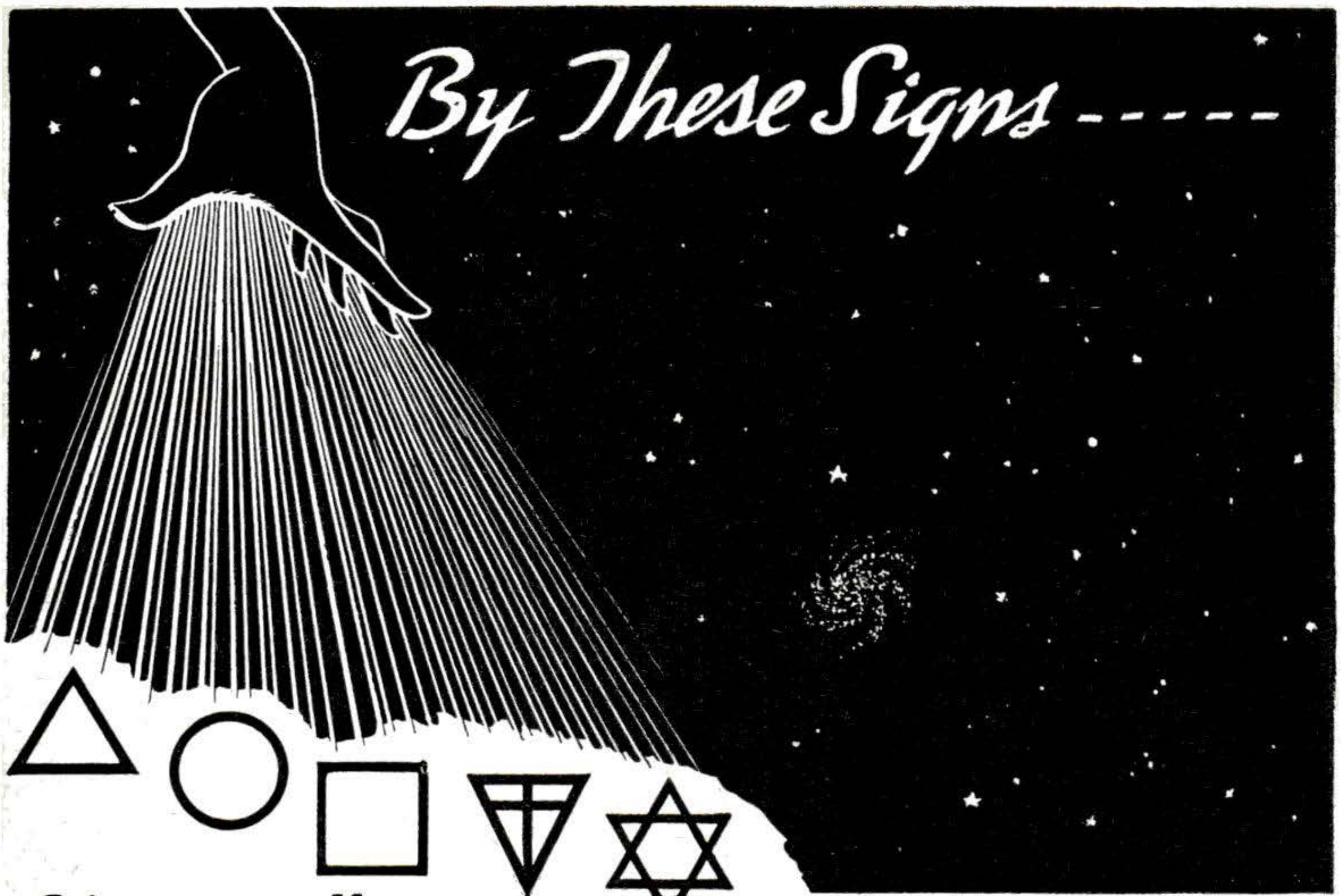

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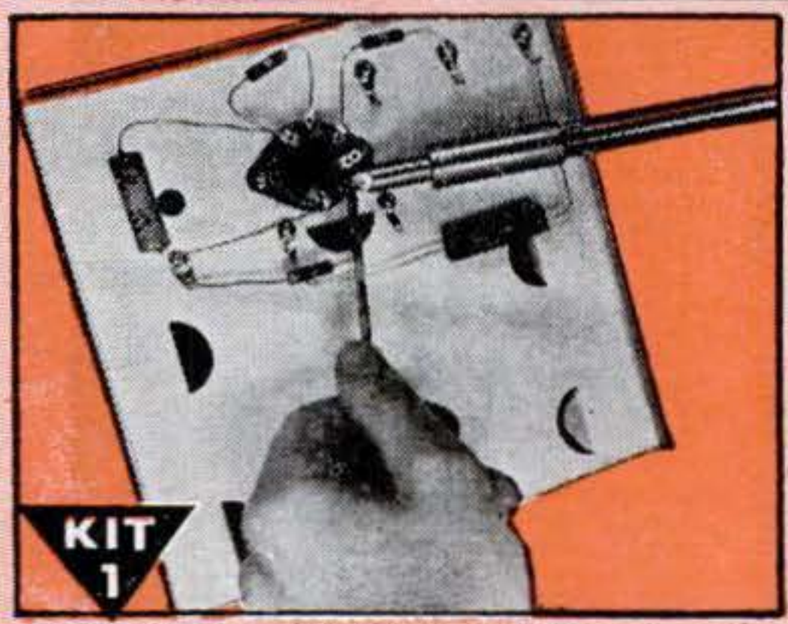

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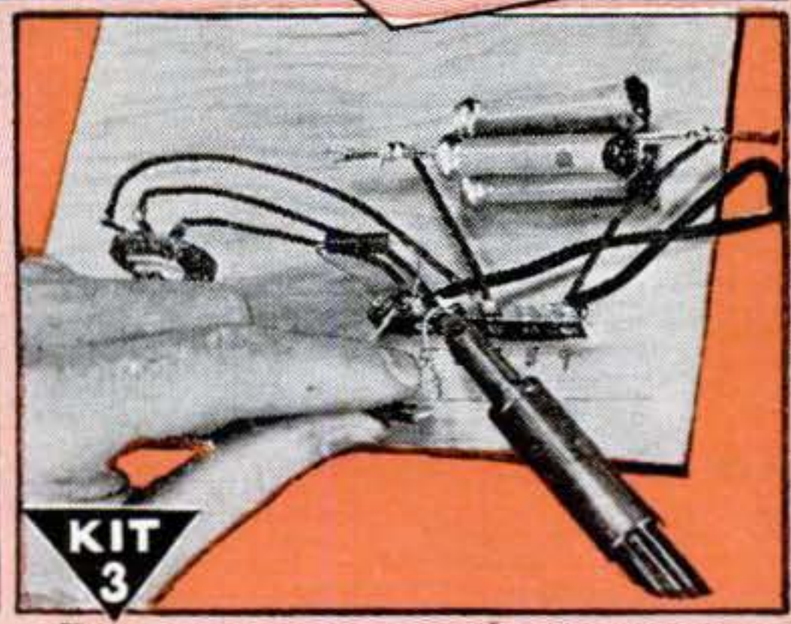

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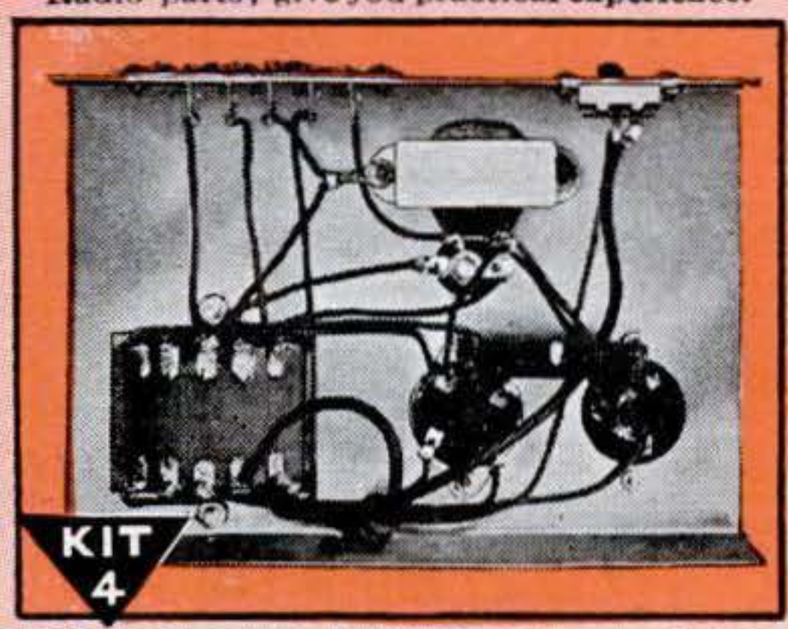

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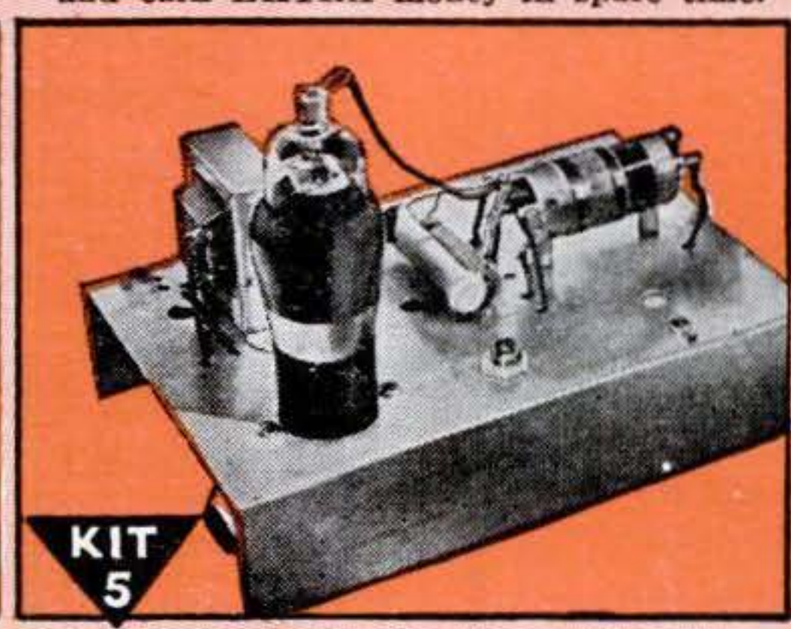

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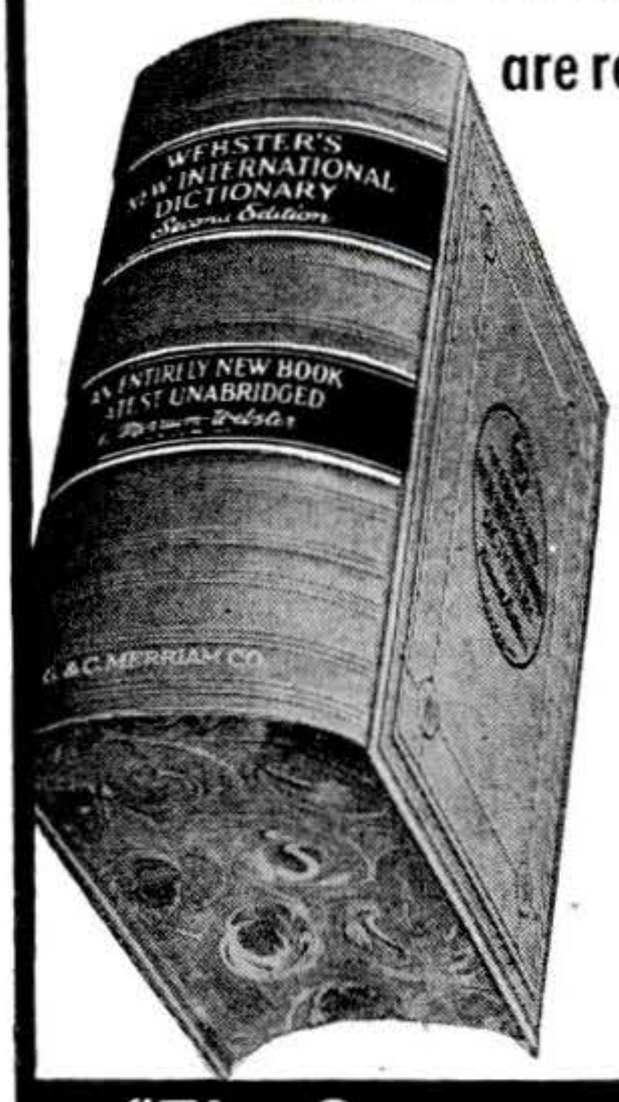

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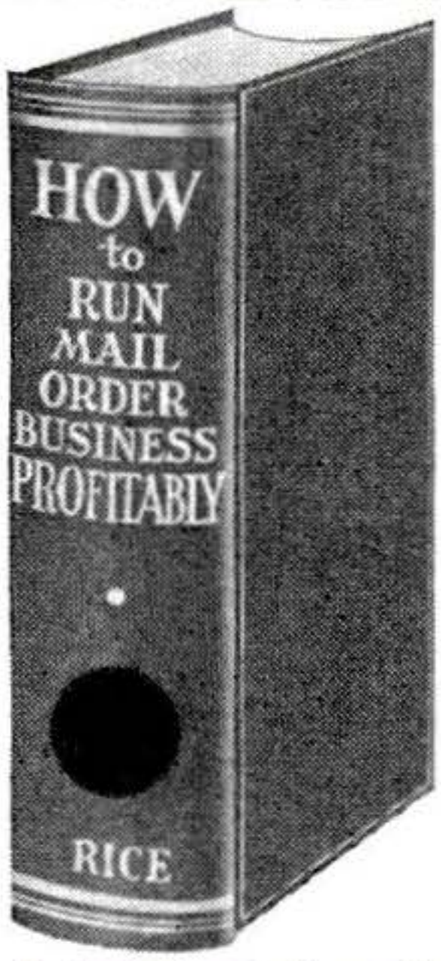

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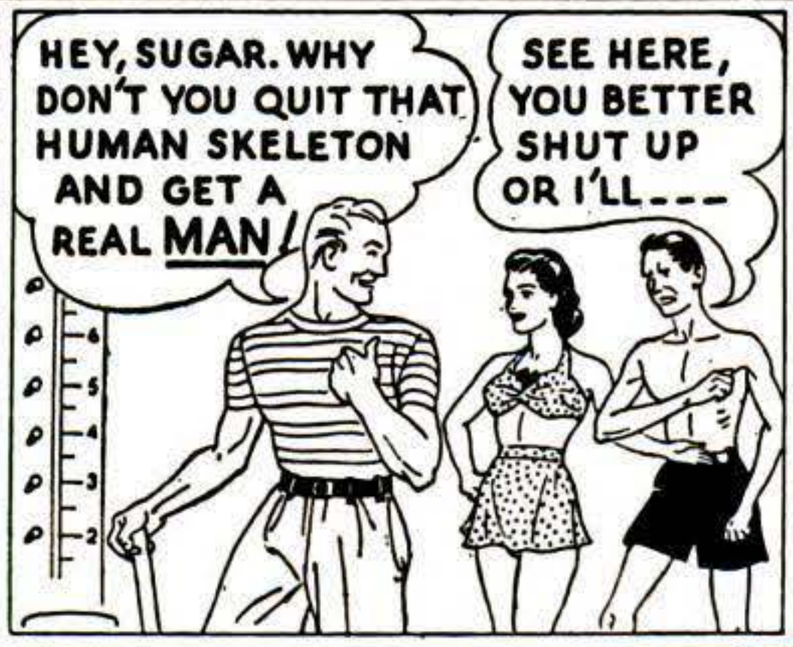

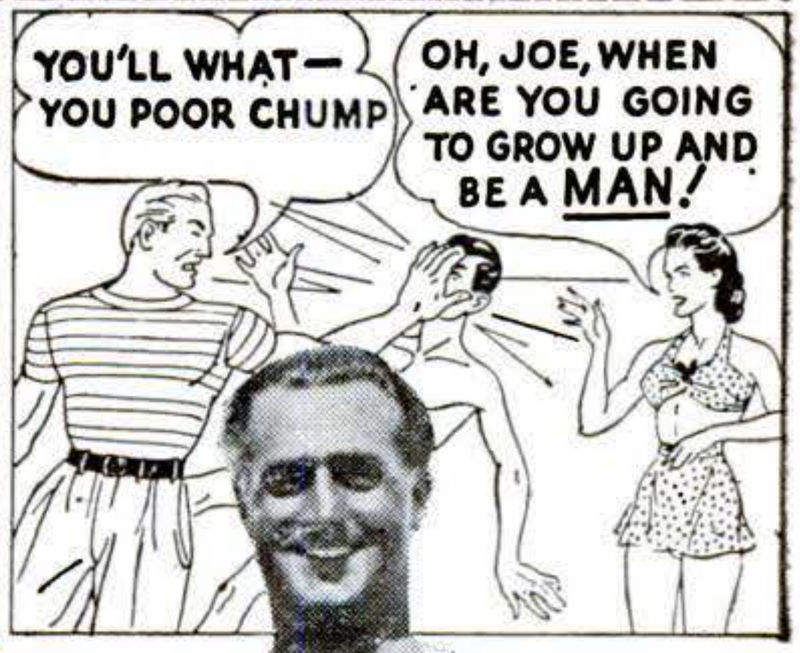

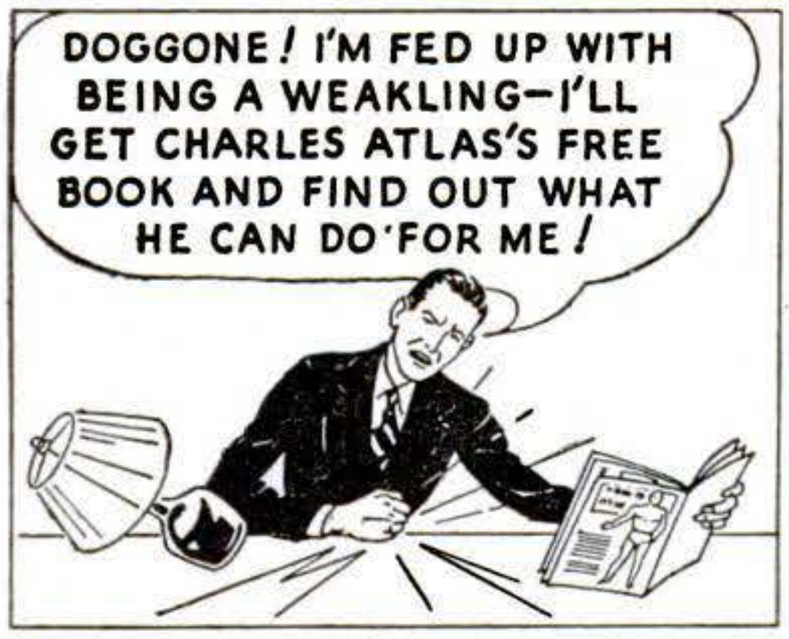

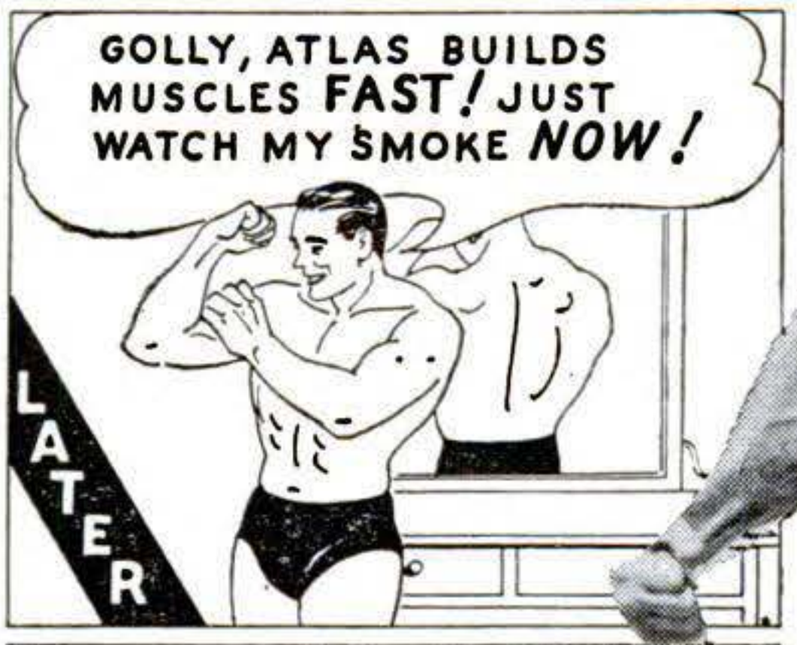

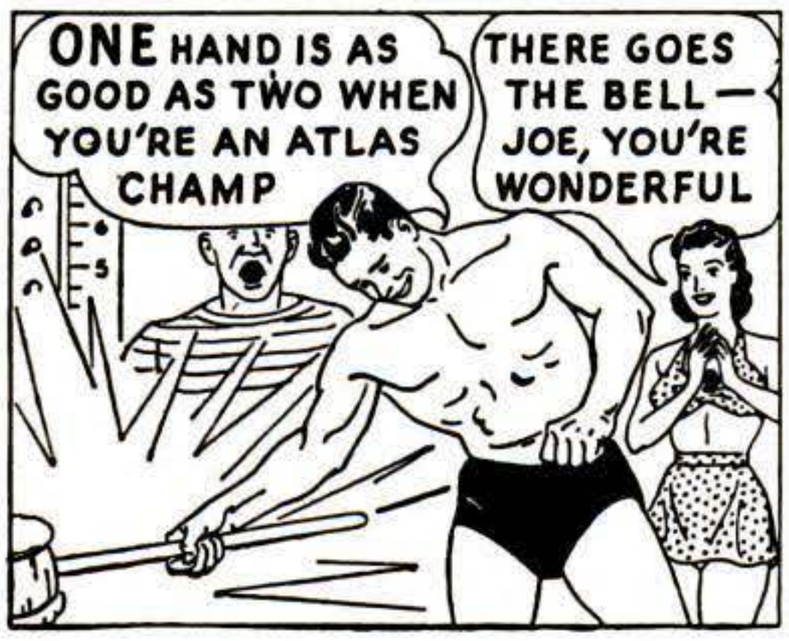

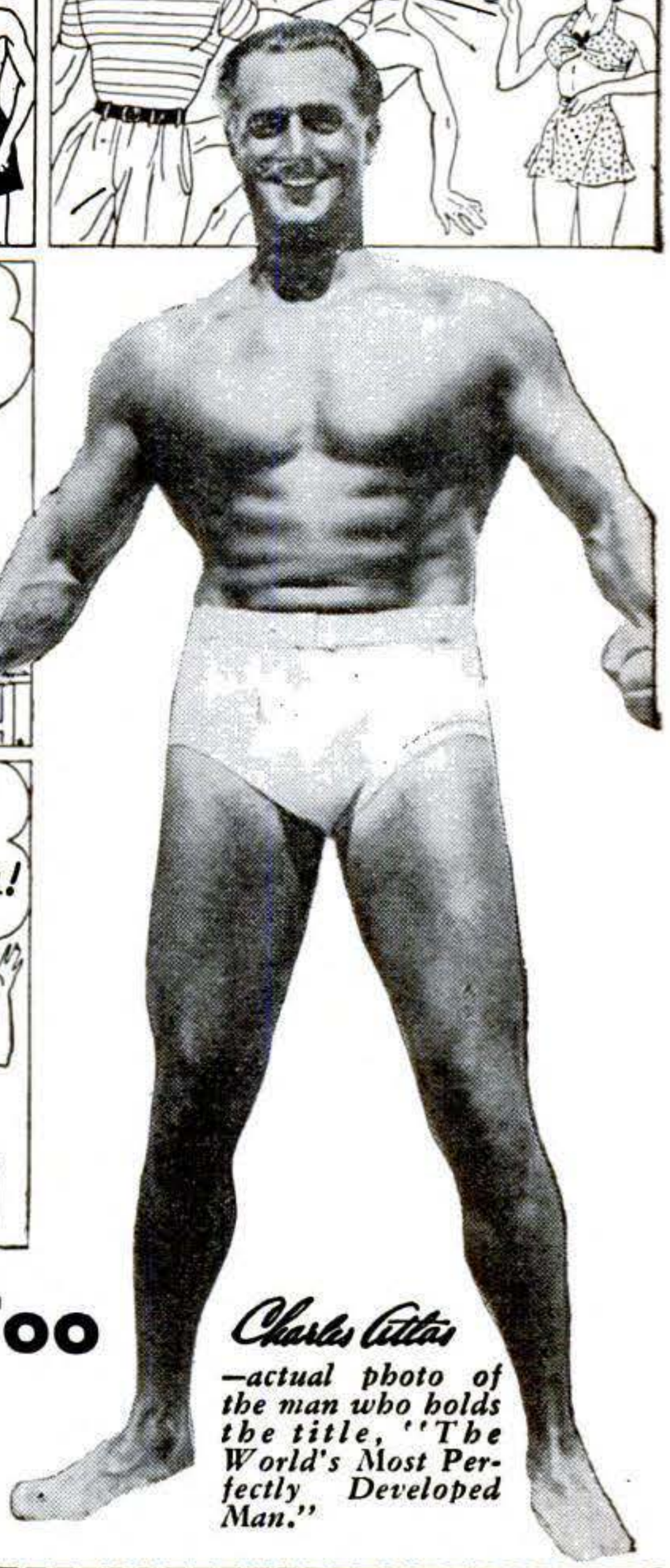

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LETTERS

Balloons for Television

Sir:

Several years ago an article on television started me wondering how the radius of the television transmitter could be substantially increased. I conceived the idea that stratosphere balloons located throughout the country could be used, with automatic relay installations in the gondolas. Today I realize the difficulty of mooring such balloons. I still believe, however, that balloons with means of locomotion to insure against excessive drifting, and equipped with relay apparatus, can step up the range of television more efficiently than airplanes, and with less expense. I believe that balloons capable of hovering for extended periods 12 miles up are feasible. At this altitude the radius of transmission would be 312 miles, and the area blanketed would be over 300,000 square miles per relay balloon. Contrast this with a 219-mile radius and slightly more than 150,000 square miles coverage for the airplane transmitter . . . .

JOHN A. LYONS

Houston, Texas

To moor a balloon 12 miles up, more than 30 tons of cable would have to be lifted. The cables would have to be marked and lighted every 50 feet to prevent airplanes from hitting them. Untethered balloons would have to be powered and controlled. If controlled by personnel, pressurization, heat, and food would have to be provided; if radio-controlled, heavy and expensive equipment would be needed. If one balloon failed, programs would cease over a large area; a dead plane could be replaced quickly.

Correction

Sir:

Recently we sent you photographs for an article on the history and development of passenger elevators. We note that your January issue carries that article, and we are astonished to find in it a reproduction of our illustration showing a typical Signal Control elevator installation on which is the credit "Courtesy of Westinghouse Electric Elevator Co." Will you kindly see that a correction is made?

OTIS ELEVATOR COMPANY
J. C. Bebb

New York City.

PSM is likewise astonished and deeply chagrined. The credit should have gone to the Otis Elevator Co. Our apologies to Otis, and a sharp reproof to the responsible editors.

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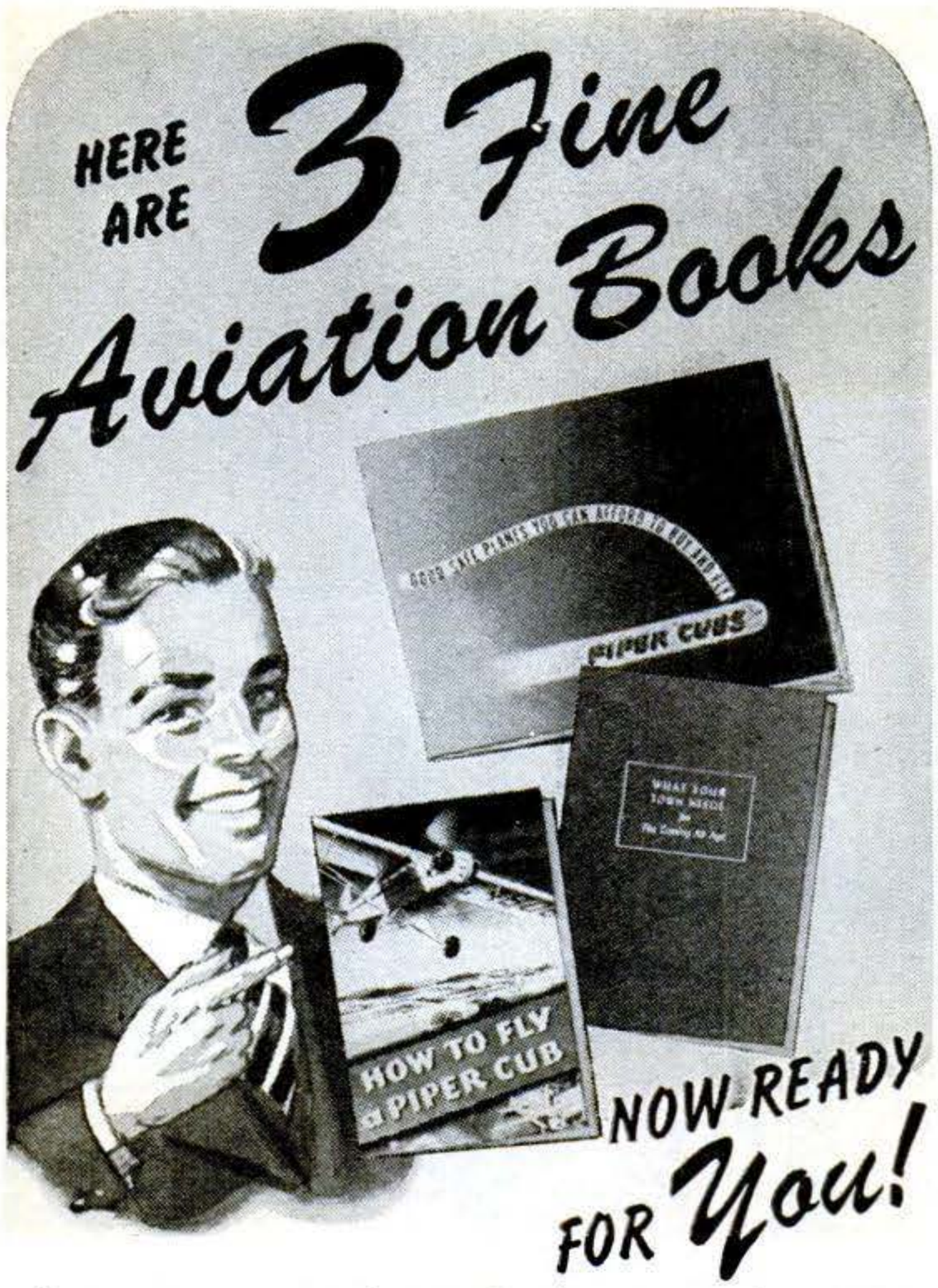

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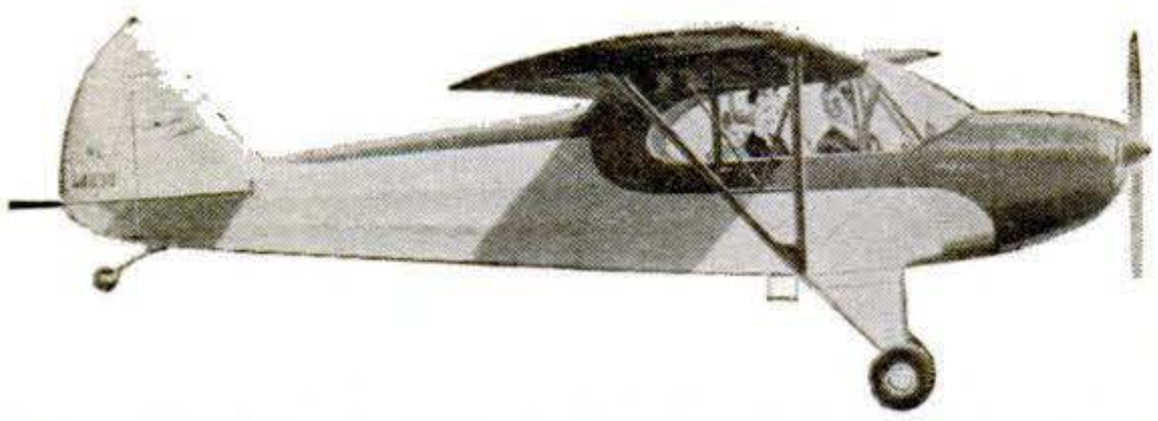

PIPER

Thanks from a Proud Sailor

Sir:

A word of thanks on behalf of all destroyer sailors for the wonderful build-up. (Tin Cans Dish It Out, PSM, July '45). I realize that it wasn't the tin cans that won the war any more than any other type of ship, but I do want to thank you for the enlightening word you published. . . . For some reason, the public has the impression that a destroyer is nothing more than an armored rowboat that the larger ships must support. I am proud of my ship . . . but she done no more than her duty.

DEAN L. COTTLE, SOM 3/C USN
USS Twining,
Bremerton, Wash.

After 21 months overseas, nearly all in the war zone, USS Twining *returned to the United States with a distinguished record. She was with Halsey off Tokyo when the war ended.*

Navy Decorations

Sir:

Since when did combat or campaign stars go on the DFC and Air Medal (as shown in PSM, Nov. '45, p. 112)? They have the oak-leaf cluster for them. Somebody had his head up, and locked.

LT. J. H. MORSE
Wright Field, Ohio.

Navy Department says it has never used oak leaves for this purpose. Navy uses stars somewhat larger than combat stars for added awards in place of the Army's oak-leaf clusters.

Time Factor

Sir:

In your Dec. '45 issue a correspondent said the term "horsepower" was used to indicate the work done to lift 550 pounds one foot. Horsepower denotes the work required to lift 33,000 pounds a distance of one foot in one minute.

RICHARD R. PERRY
Wrangell, Alas.

Our correspondent should have said "550 pounds one foot in one second."

Contents

Sir:

Your table of contents isn't much use in looking up articles in PSM. You are much too stingy with the space you give to this feature of the magazine.

IRVIN N. REEVES
Atlantic City, N. J.

It has been enlarged to include all the leading articles and departments under topical headings for easy reference.

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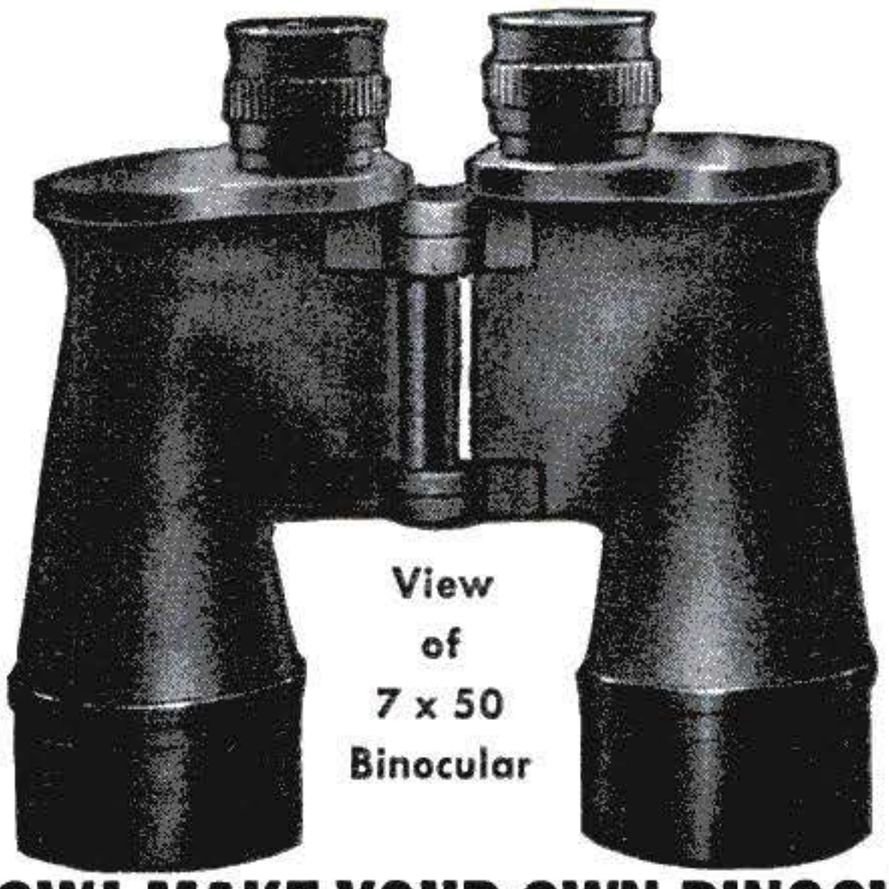
BARGAINS in WAR SURPLUS LENSES & PRISMS



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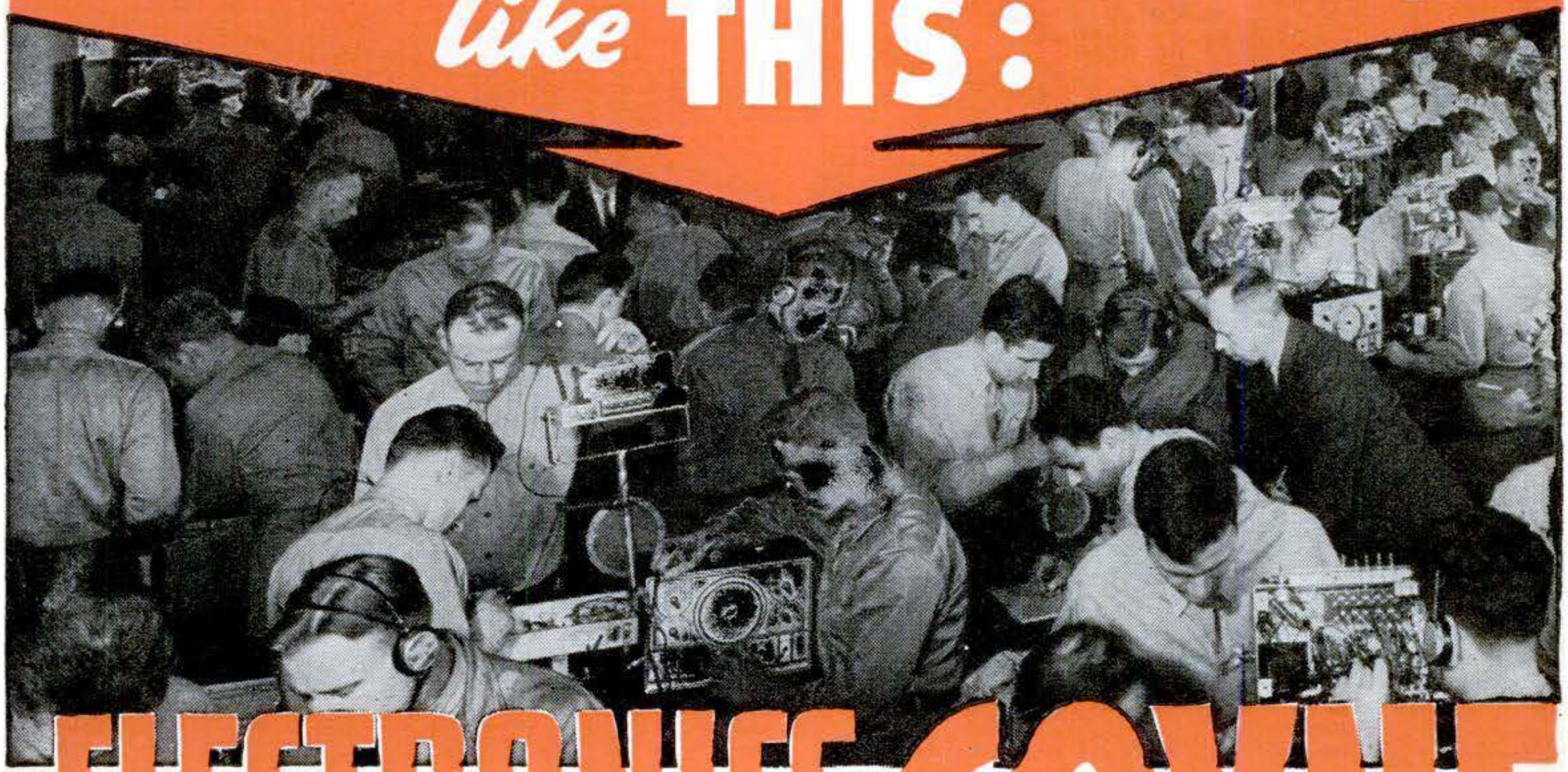

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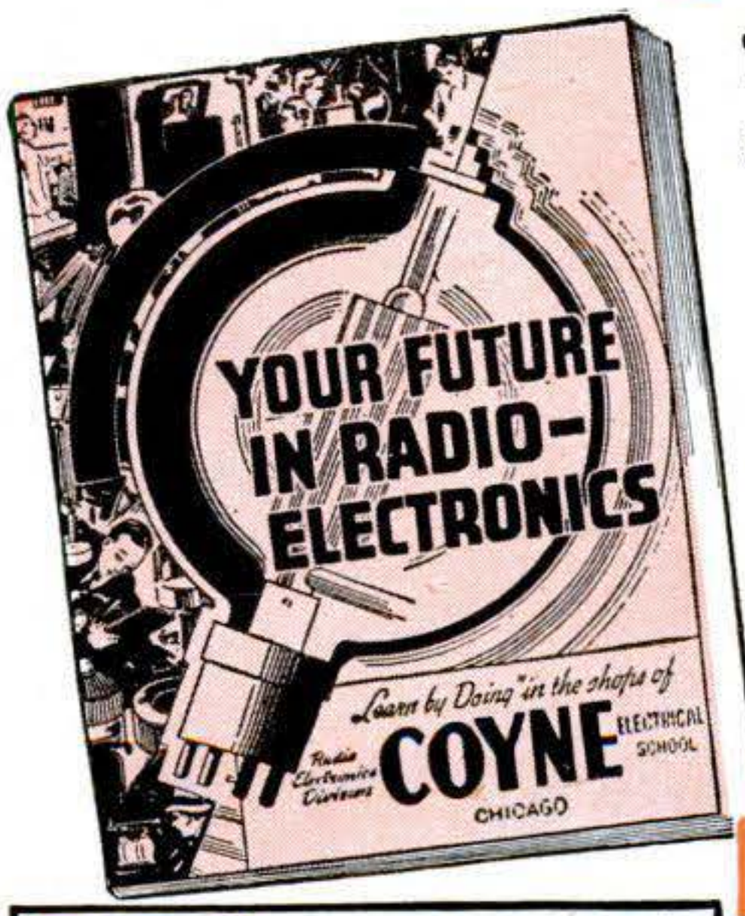

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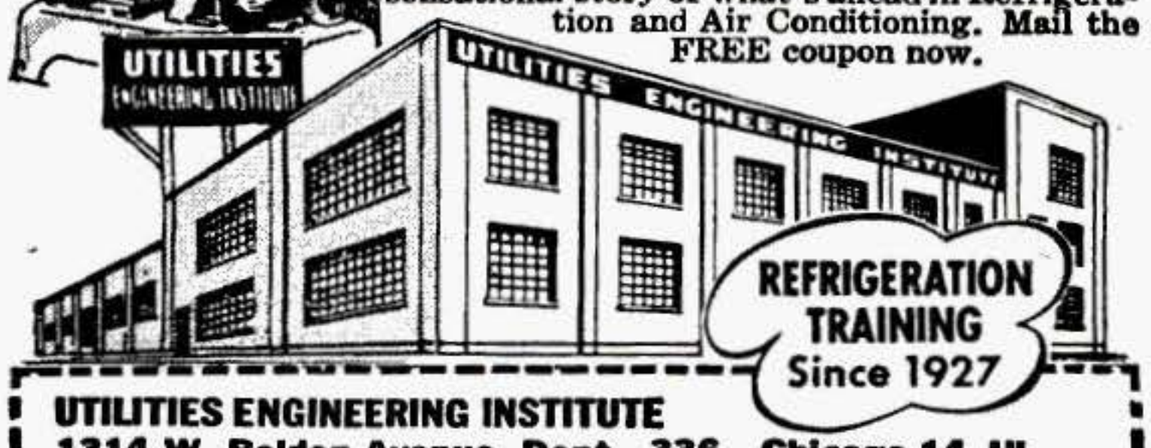

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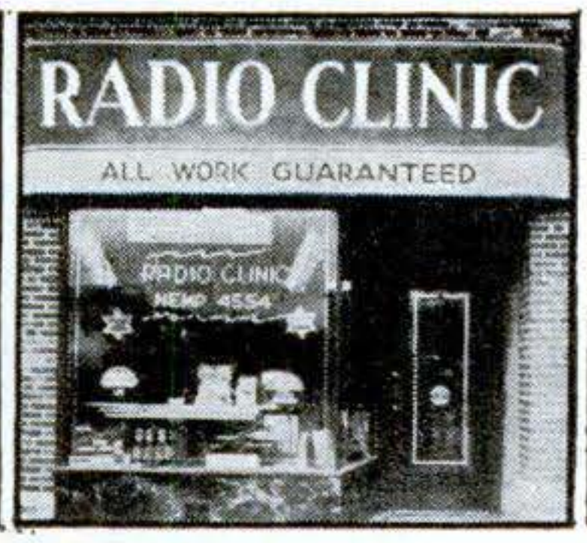

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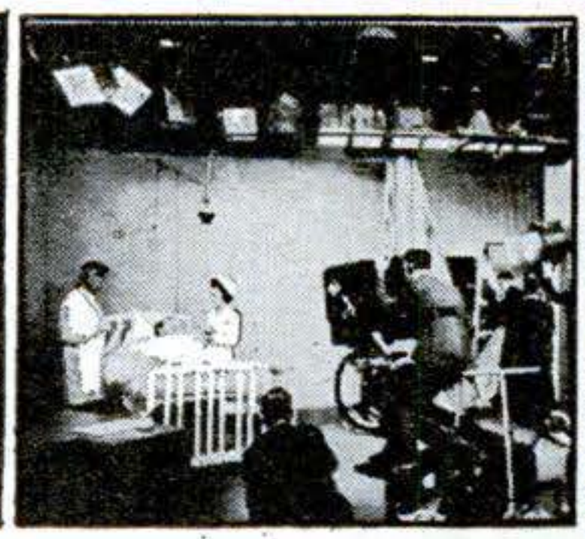

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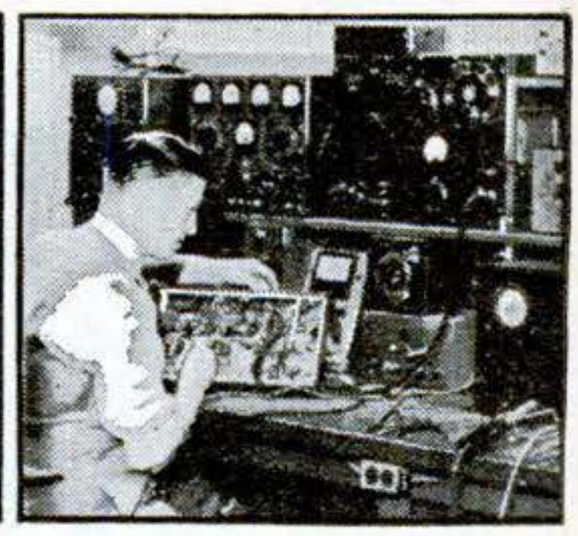

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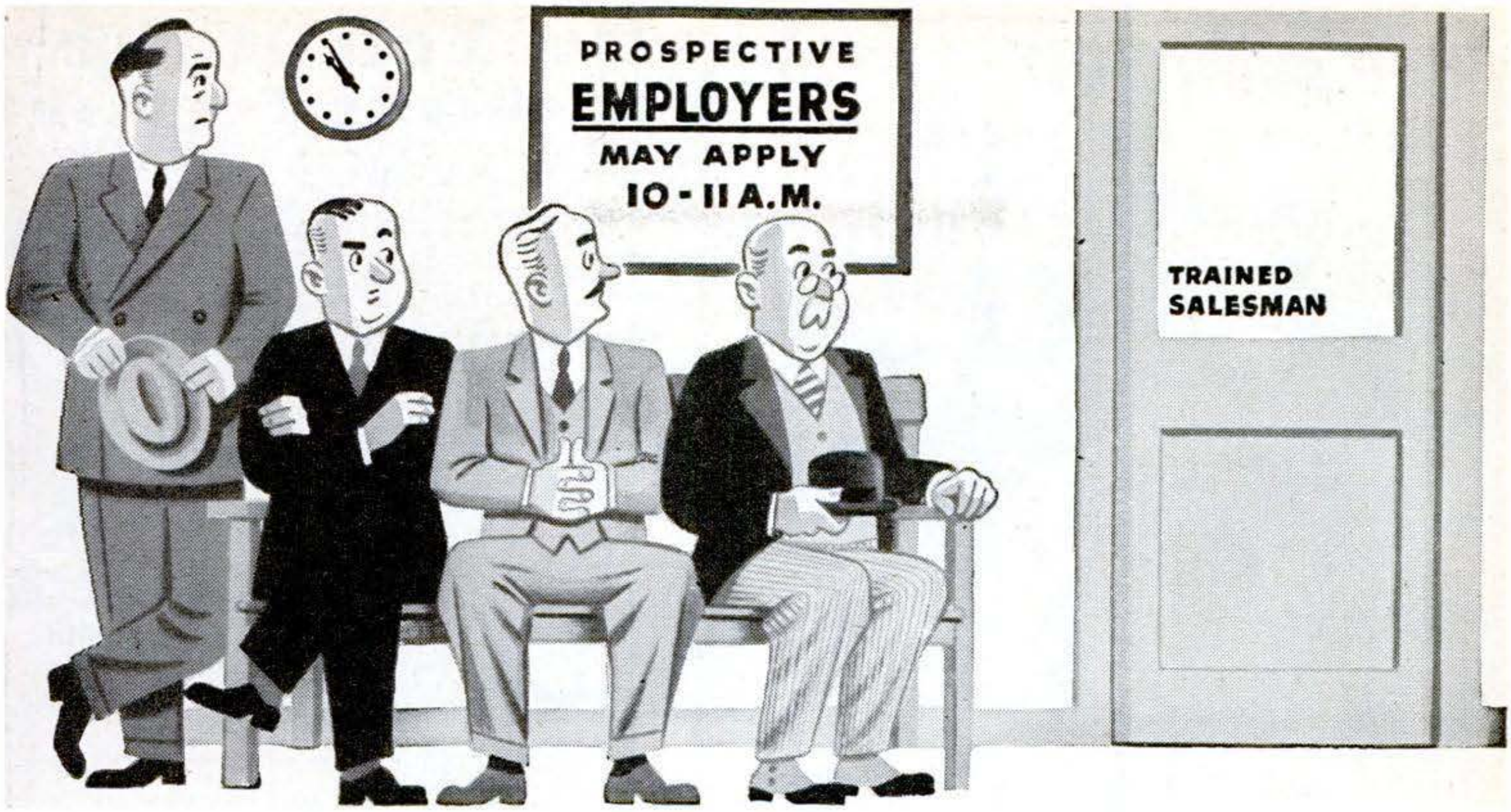

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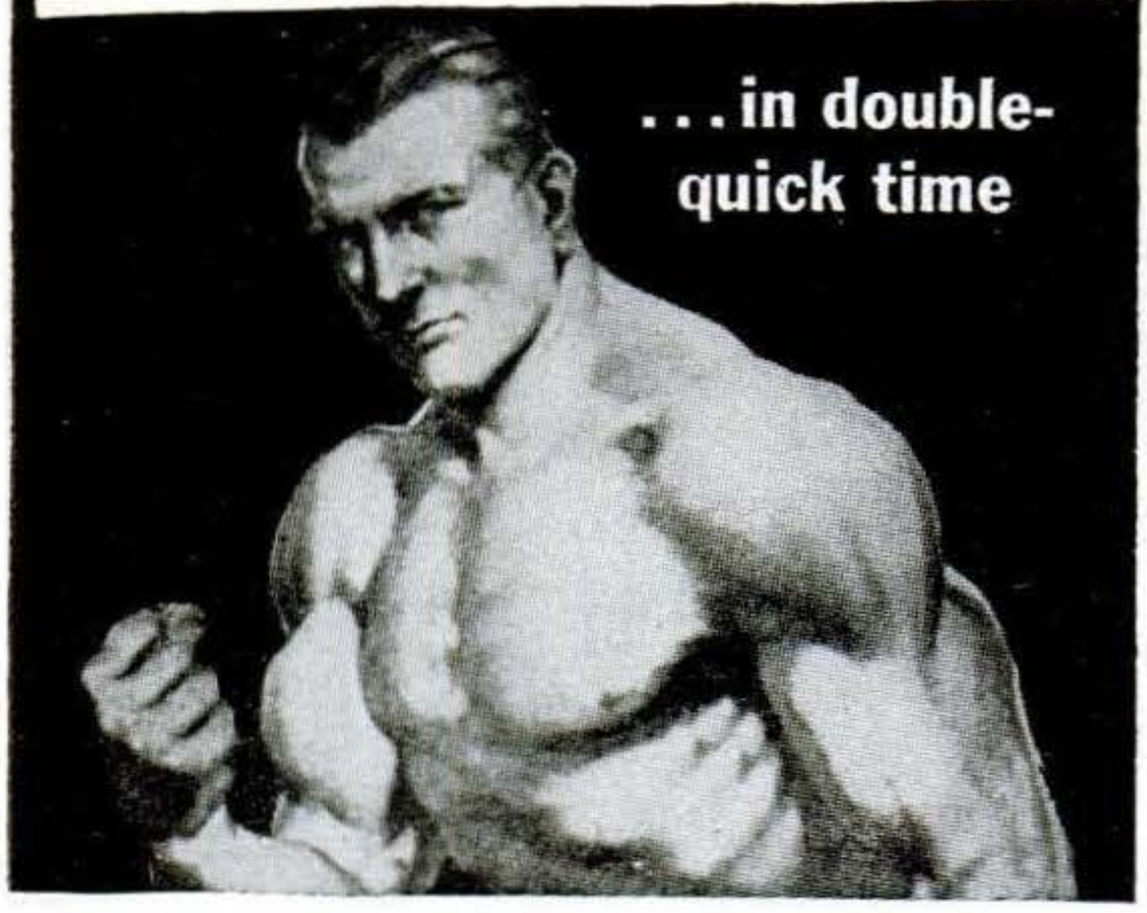

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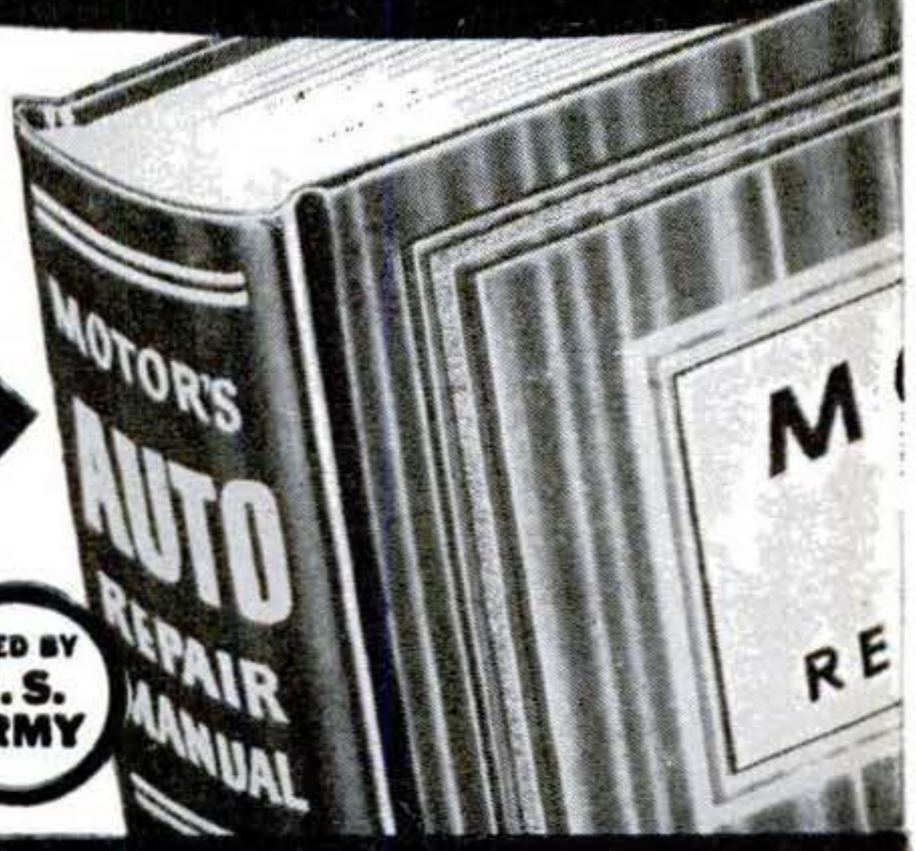

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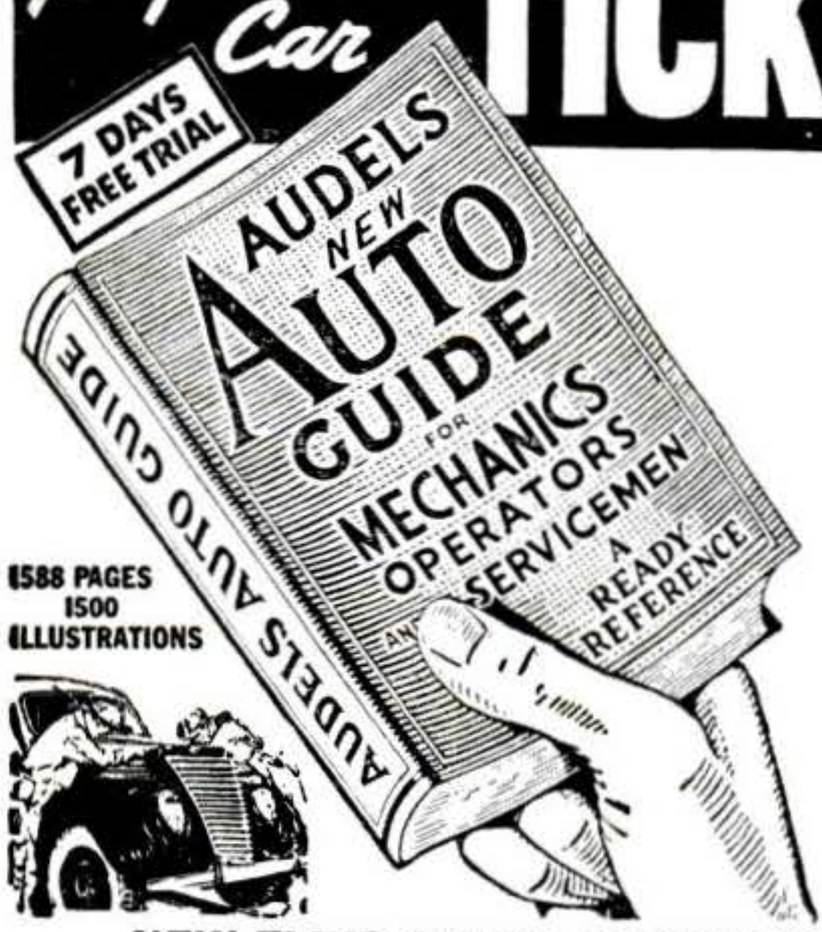

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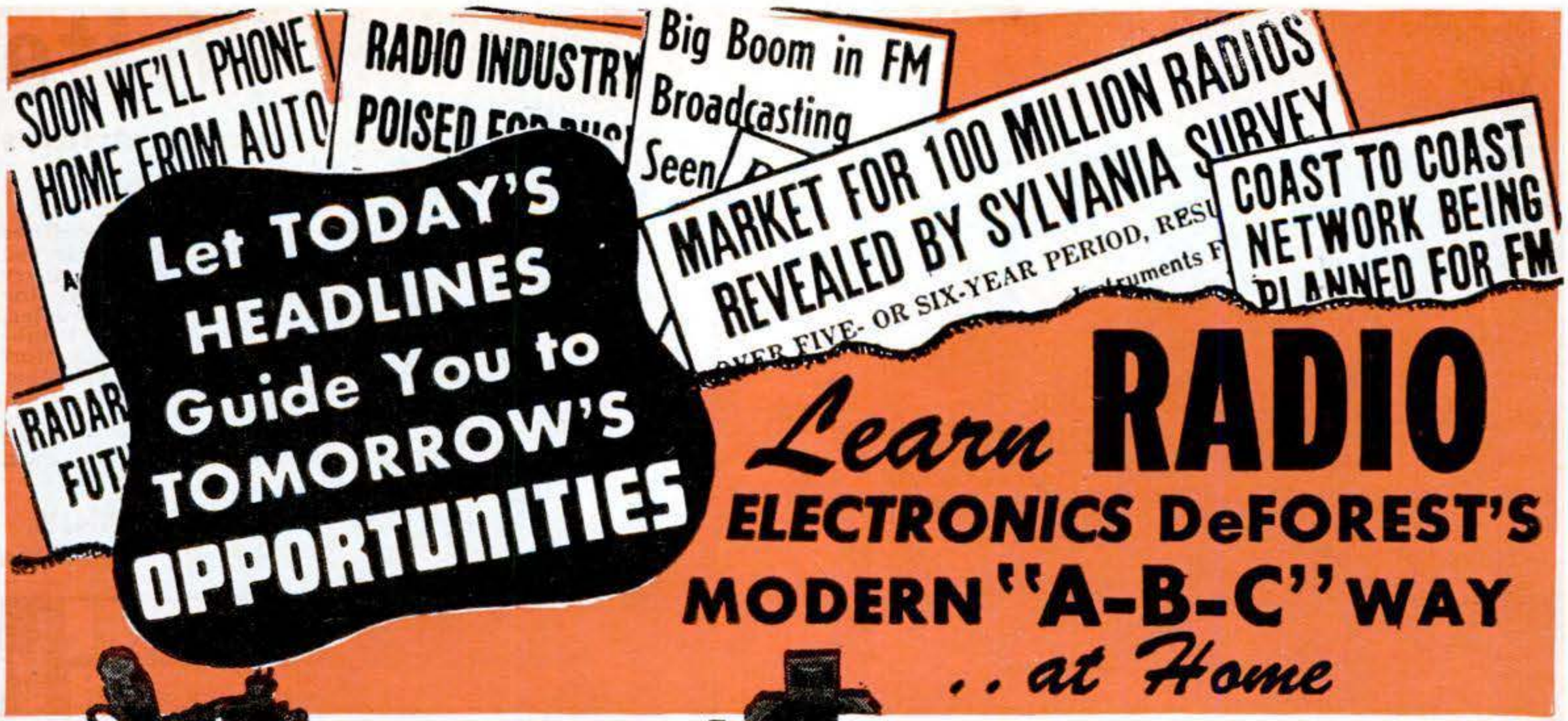

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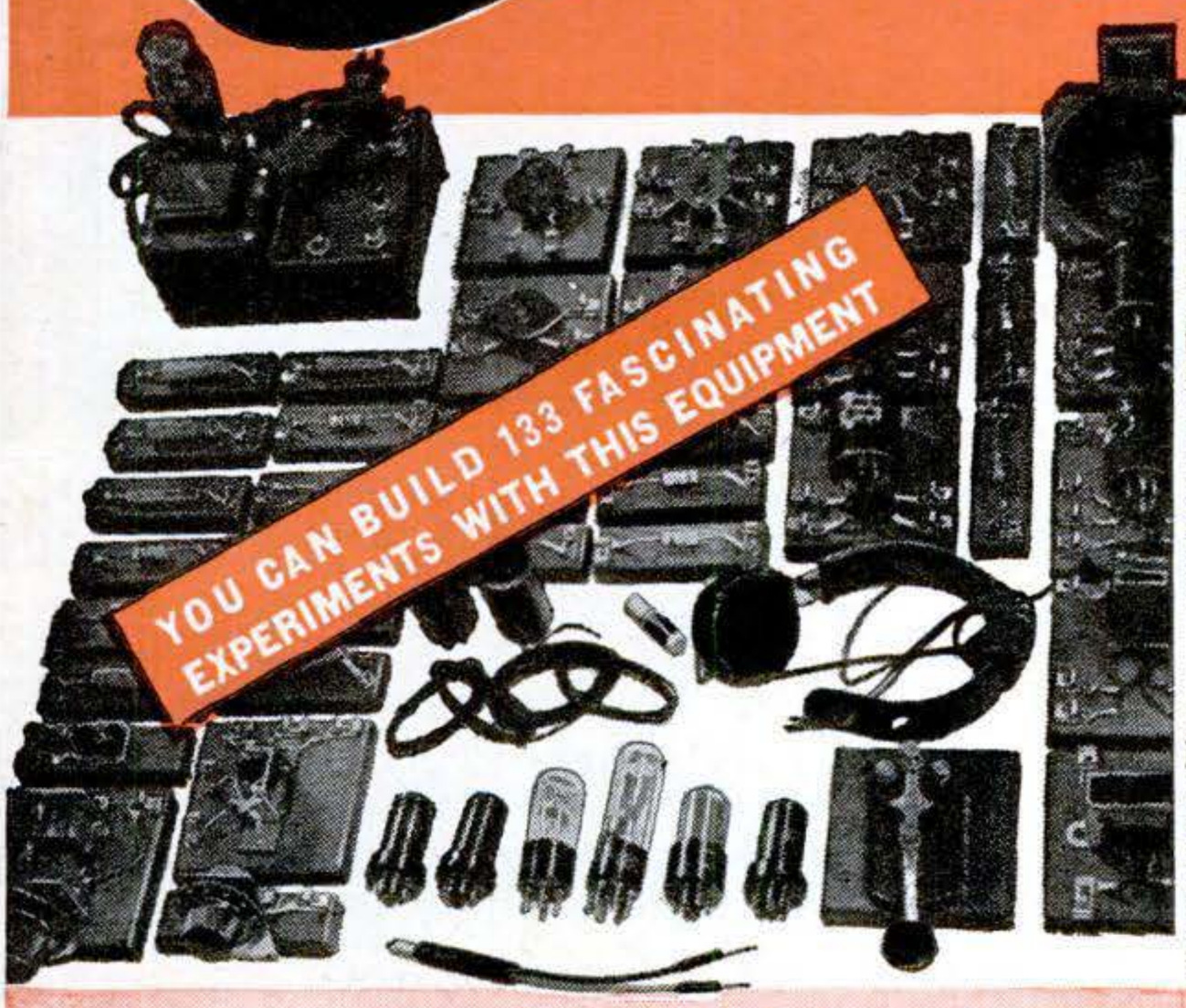

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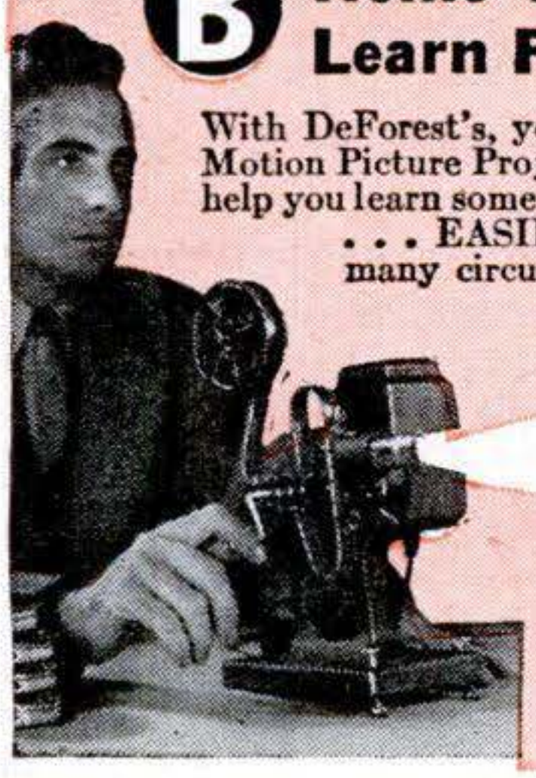

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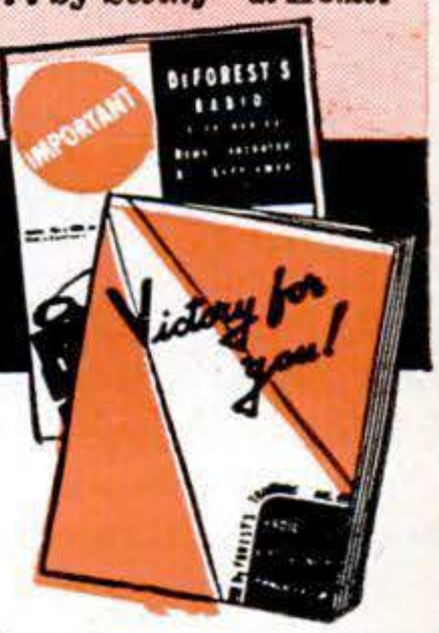

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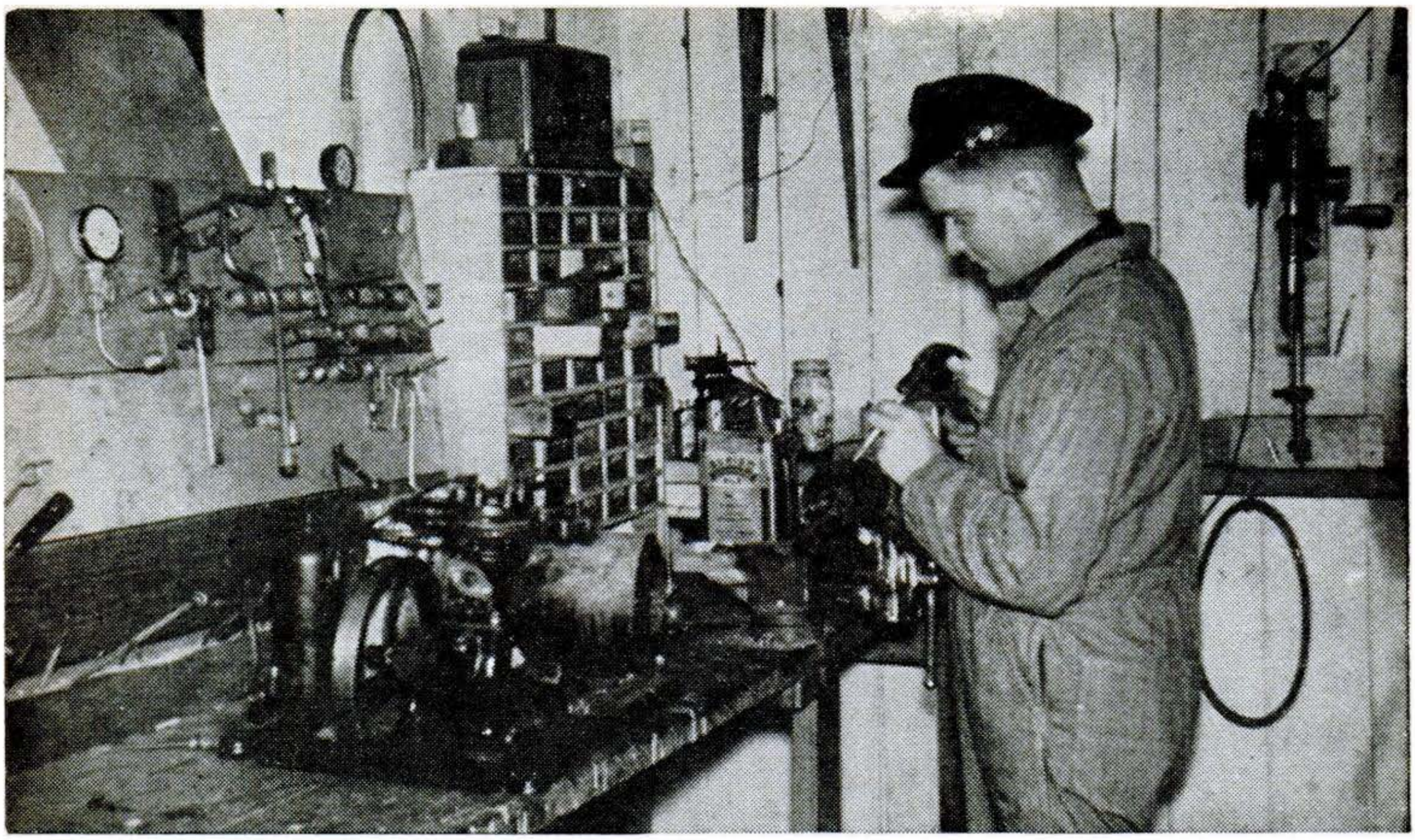

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By S. T. CHRISTENSEN

the "Fix-it Man"

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At first, I let the owner decide the charge and, frankly, I was amazed at what I earned per hour. But then, when one figures what initial costs are involved in buying most electrical appliances, one can readily see that spending extra dollars for repairs is well worth while. Before long I was making more in my spare time repairing than from my regular job. The result . . . I went into business for myself. When war came, business boomed, for new appliances were not available.

For a while, repair parts (needed on some jobs) were a little difficult to get. But that situation quickly adjusted itself and many repair parts were given the high priority rating of AA2. After all, we had to provide for the health and well-being of our civilian population.

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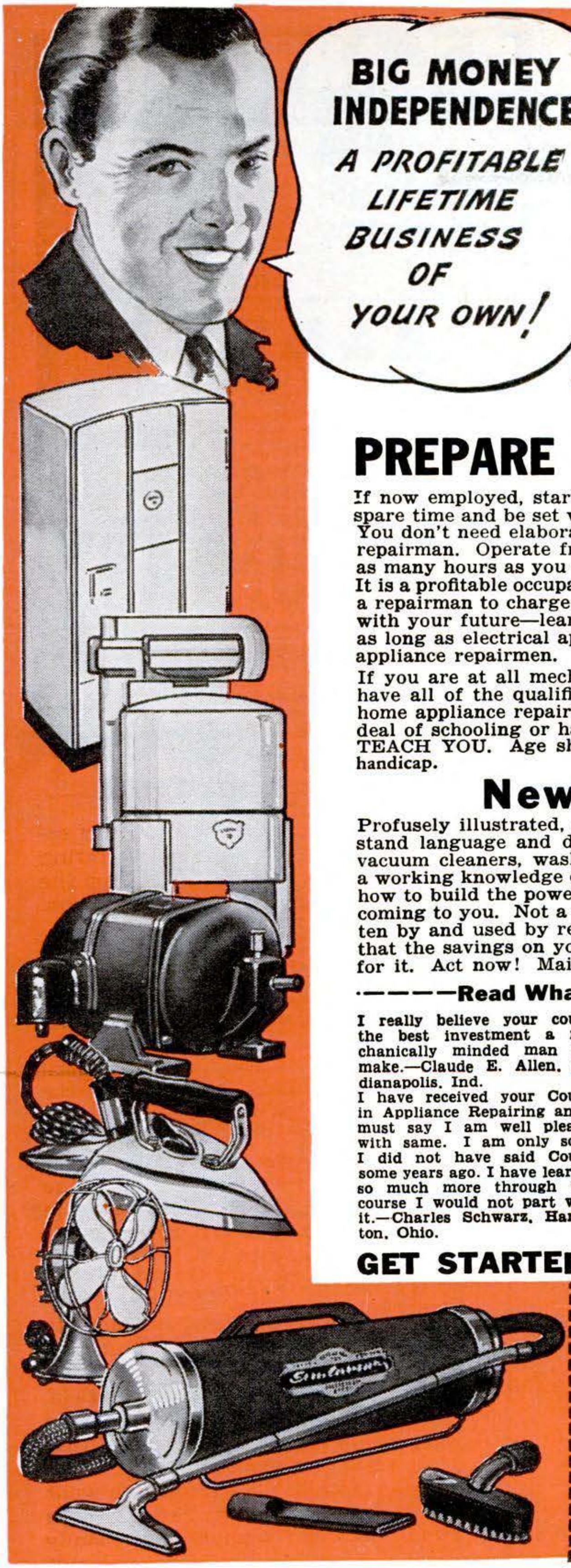

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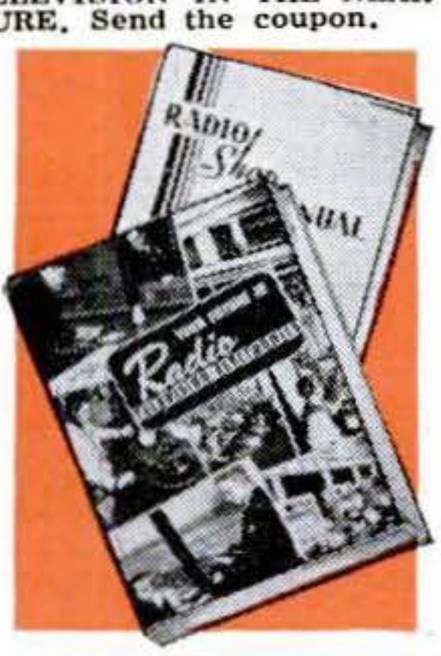

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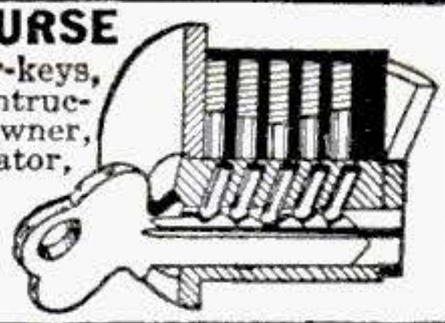

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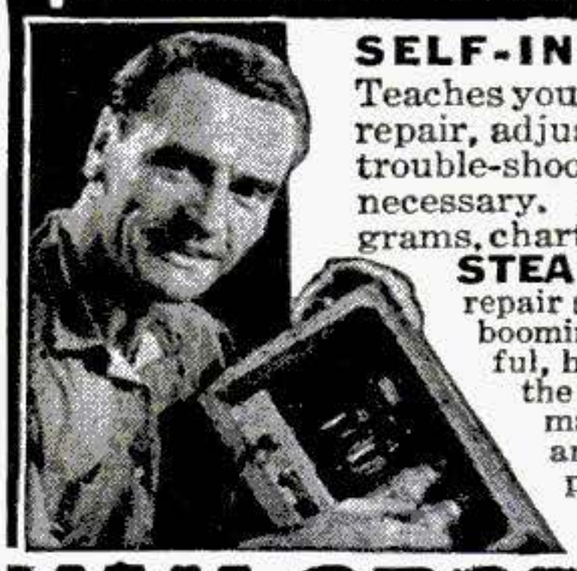

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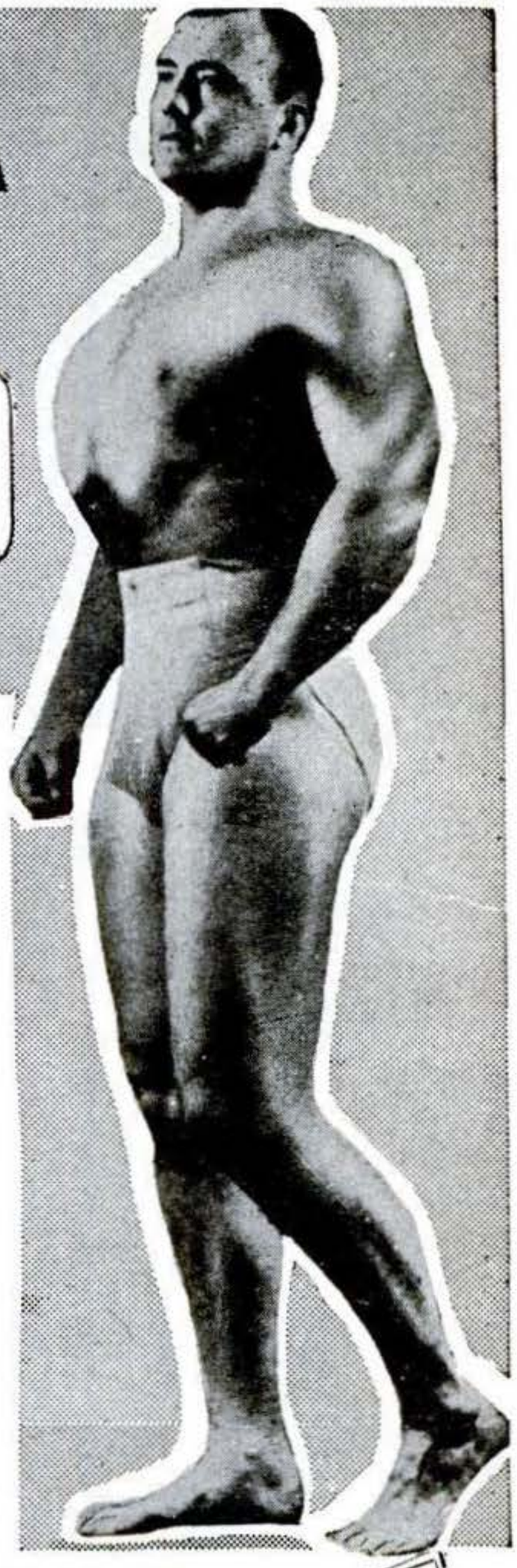

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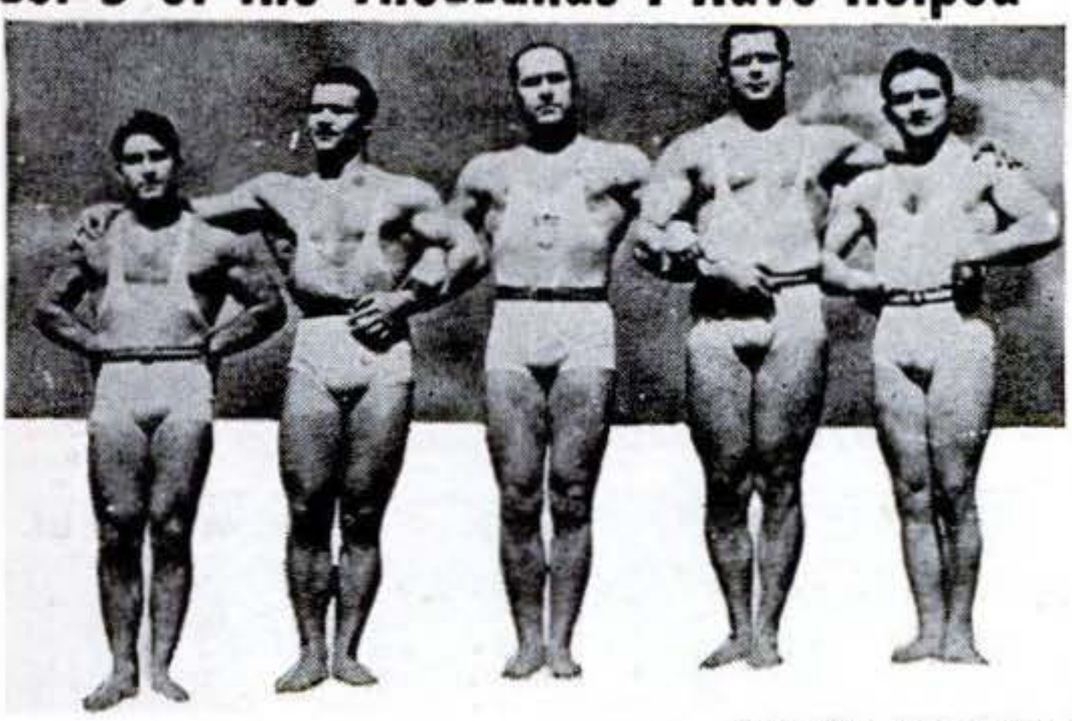

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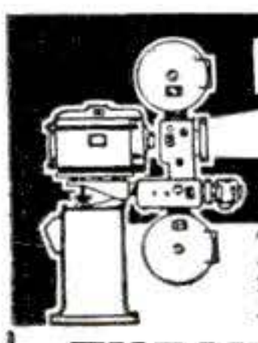

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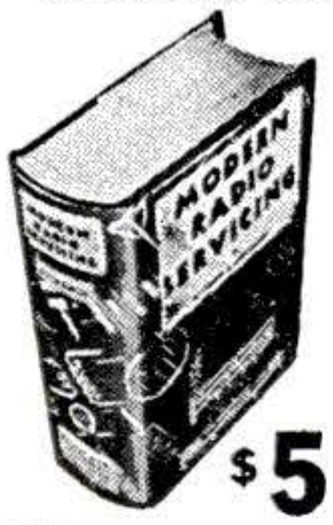

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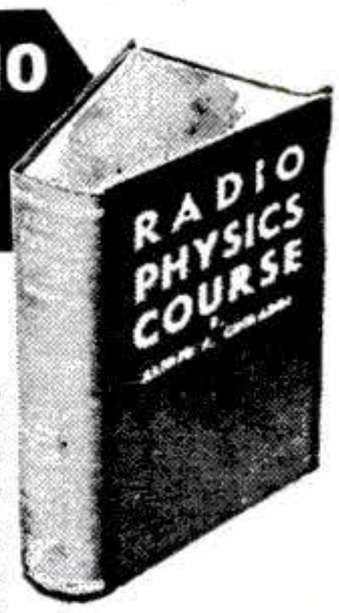

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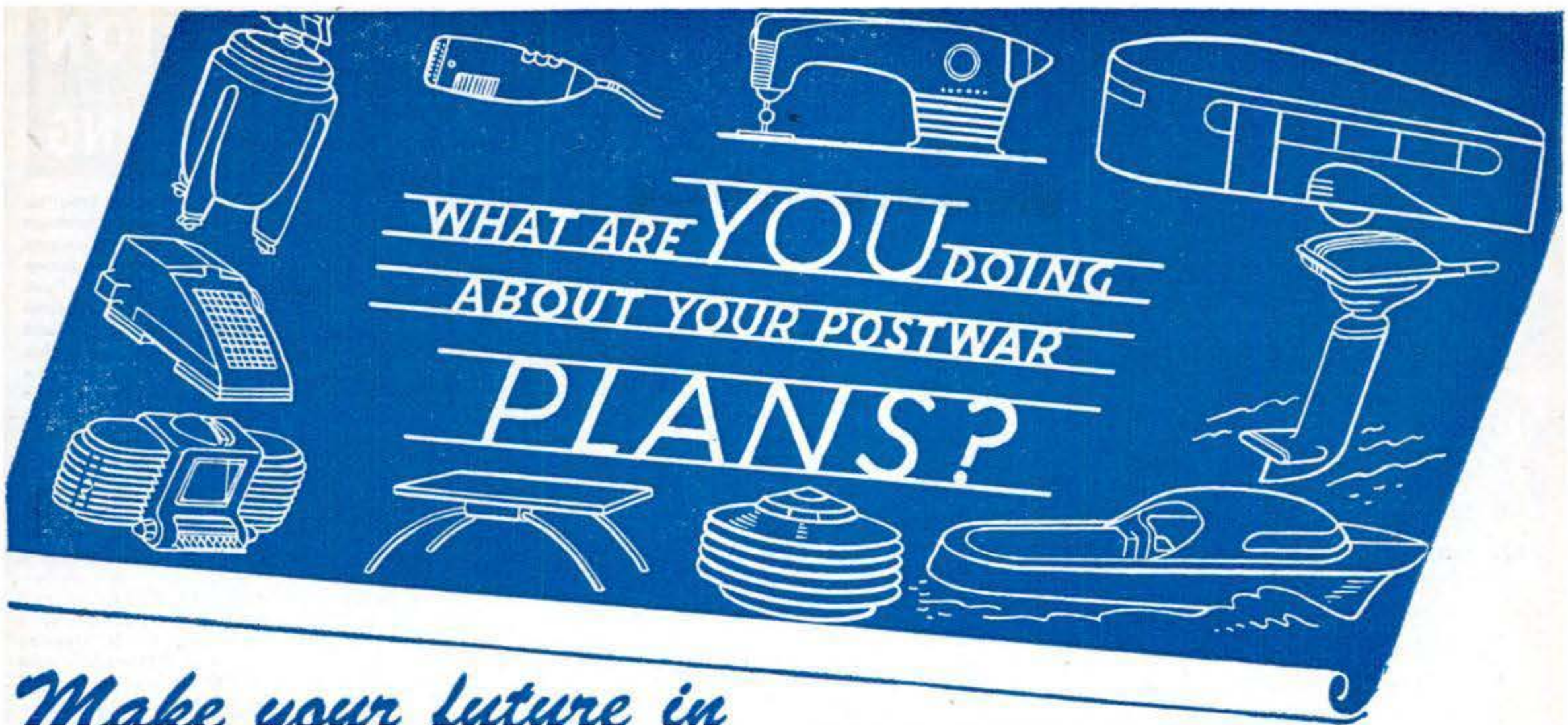

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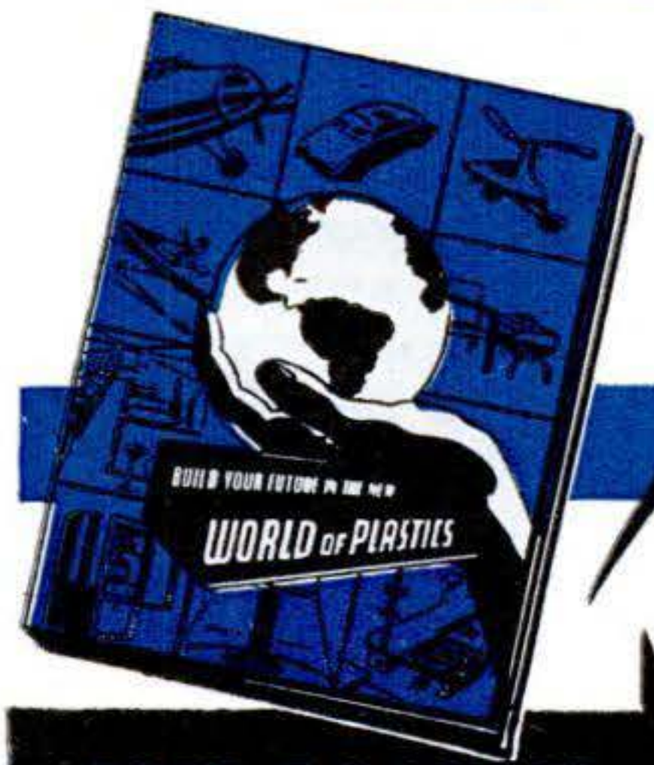

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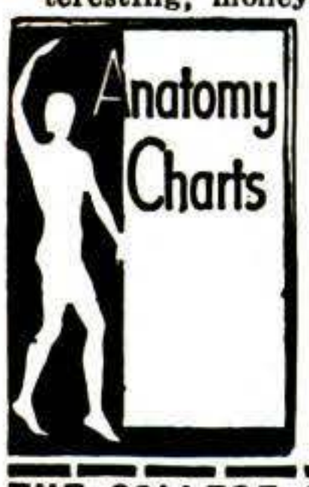

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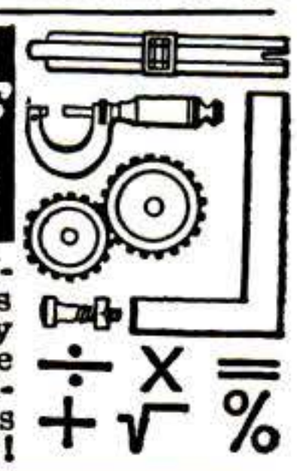

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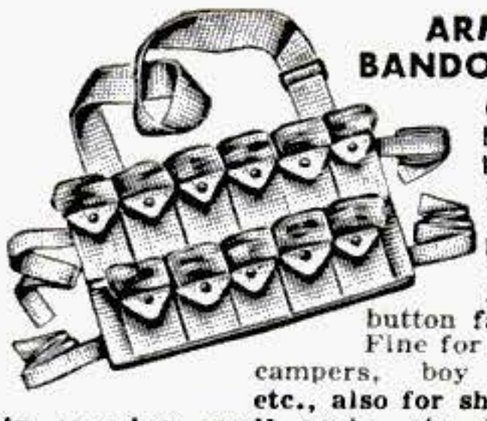

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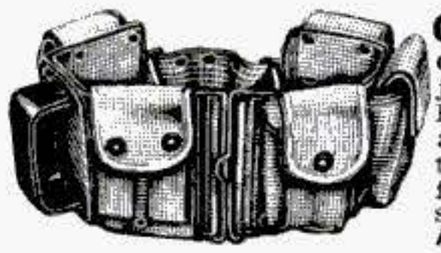

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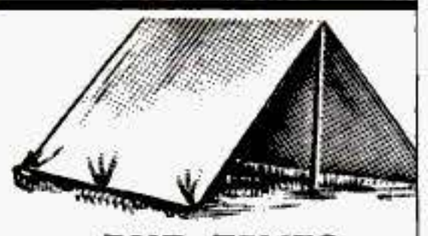

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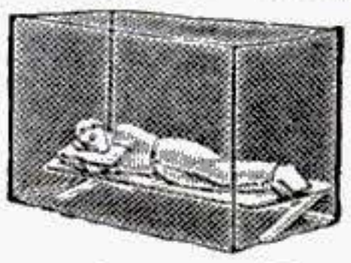
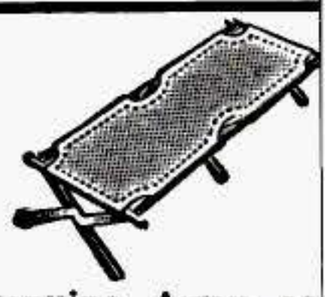


Of marquisette with taped seams. Metal rods and bar included. Covers cot o hammock. Brand new.

A104—EACH..... **$2.95**

ARMY COT



Brand new, genuine Army co purchased from U. S. Gov't. Fine for hunters, fishermen, boy scouts, etc. Extra heavy canvas reinforced webbing, for rough usage plus all-around comfort 27x78 inches. Hardwood frame supports 1,000 lbs. Fits in mosquito tent. A real buy Shpg. Wght. 25 lbs.

R232—EACH..... **$5.95**

AMMUNITION BOX

Fine for storing valuables, carrying lunches, etc. Of heavy gauge 7½ x 11 x 4 inches. Fireproof. Hinged lid with folding handle. Olive drab finish. Used, but perfect. Shipping wt. 4 lbs.

A525—EACH..... **25c**

DIVING MASK

See clearly under water. Close fitting, water-proof construction shuts out all water. Also ideal for cycling, other outdoor sports. Protects eyes from dust and wind. Excellently made of fine rubber. Shpg. Wght. 1 lb. R207—Per Pair..... **$2.25**

MARINE KNIFE

Fine for boy scouts. Blades include knife, bottle opener, screw driver and reamer. All metal handle 3¾ in. long. Weight 1 lb. Stock No. 107—Each..... **$1.95**

SWIM FINS

More Speed! More Fun! Less Effort! Tiny flutter sends you "scooting". Amaze your friends with your speed. Indoor pool or open water. Used by Life Guards. Great for spear-fishing, other underwater sports. Made of rubber to fit over heel. Shpg. Wght.—5 lbs.

R533—Pair—Only..... **$9.45**

7-LB. EXPERIMENTER PARTS ASSORT.

A "gold mine" for the radio serviceman. Hundreds of valuable radio parts, new radar and electronic parts and sub-assemblies, coils, resistors, trimming condensers — worth many times this low price.

A130R—7 LBS. **$1.79**

MICROPHONE BUTTON

Brand new! For experiments in radio, electronics and other electrical apparatus. Used in telephone, amplifier and detectaphone work. Diameter 2½ inches. New.

A512—EACH..... **98c**

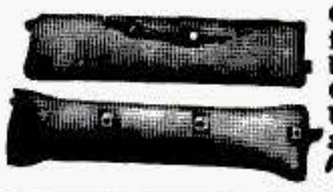
RADIO HEAD PHONES

Extremely sensitive with 4000 ohms resistance. Brand new and fully guaranteed. With moisture-proof cord and phone plug. A splendid value for the radio serviceman and experimenters.

A106—PAIR..... **$2.95**

New supersensitive phones. A108—Pair..$5.95

COMB. AIR PILLOW-LIFE BELT



Of rubberized khaki 10 x 40 inches in size. Used as life belt, raft or air pillow. Quickly inflated or deflated. Used but guaranteed water and air tight.

A127—EACH..... **98c**

BICYCLE POUCH

Heavy canvas pouch. Attach to bicycle for lunches, shopping, books, etc. Has three 11x12 inch pockets. Used, and slightly soiled, but in good usable condition. Has oversize flap with single strap fasteners.

A113—EACH... **$1.69**

27 LENSES, ALL NEW, PERFECT.

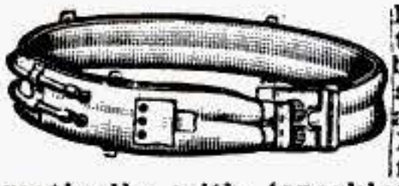
For experimental work in optics. Consists of 27 precision ground and polished prisms and lens elements in assorted diameters and focal lengths. Big variety, positive, negatives, etc. Actual value over $100.00

A519—27 PIECES.... **$7.95**

50 LENSES SEMI-FINISHED

Lenses similar to above but not polished. All are blanked and formed ready for polishing. Negatives, positives, and prisms in Crown and Flint glass. Worth many times this low price. A520-50—LENSES, ONLY..... **$1.95**

LIFE PRESERVER BELTS



Right from the invasion beaches. Consists of two air chambers. May be inflated automatically with 'sparklet' cartridges or manually by attached hose. Adjustable in waist size. One air chamber guaranteed air tight—other may need a tire patch. All belts are used and slightly soiled—but a bargain at this low price.

No. 1261 Each..... **$1.00**

ORDER DIRECT FROM THIS AD

Values galore! Hundreds of hard-to-find items for home, shop and outdoors. Make remittances by money-order, bank draft or personal check. Send 25% deposit on C.O.D. orders. No C.O.D.'s on orders for less than $5.00. Include sufficient postage on parcel-post orders—any overage will be promptly refunded. All quotations F.O.B. Chicago. Used items and materials are guaranteed serviceable and as described. Your money back if not more than satisfied.

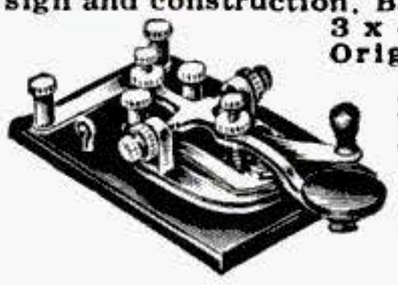
BIG ILLUSTRATED CATALOG FREE

STARK'S

Dept. PS346
509 So. State St.
CHICAGO 5, ILL.

PROF. TELEGRAPH KEY

Purchased from the gov't. Finest design and construction. Base measures 3 x 4¾ inches. Original value $2.50. All parts of instrument brass. Adjustable.



A147—each **98c**

POPULAR SCIENCE Classified Opportunities

Save time—Save Money

Classified Ads only 50c per word per insertion, payable in advance. Minimum ad 10 words. To be included in April issue copy should be in our office by March 1st. April issue on sale April 1st.

POPULAR SCIENCE MONTHLY—351 FOURTH AVE.—NEW YORK CITY 10

1 ADVERTISING

ADVERTISING Placed everywhere lowest rates. Reliable guidance on publications, expert assistance on ads without charge. Newspaper, magazine, mailing-list rate-book free. Chicago Advertising Agency, 20-MP West Jackson, Chicago 4.

ADVERTISE 24 words, 40 Newspapers $3.50. List Free. Advertising Bureau, 4515-P Cottage Grove, Chicago 15.

ADVERTISING: Placed in any publication, anywhere. Write for Mail-Order rate folder "P". LeGrand Adv. Agcy., (Established 1923) Floral Park, N. Y.

EASILY made, colorful silk screen process displays needed everywhere. Spare time practise starts your own high profit business. Participate in advertising boom quickly, economically. Booklet with 3-color silk screen cover sent free. California School Screen Process, Dept. PSC-346, 2710 So. Spaulding, Los Angeles 16, Calif.

24 WORDS in 64 Weeklies $4.96. J. Darnell, 730 Hays, Jackson, Tenn.

SALES Letters—We'll write you a dynamic sales-producing sales letter for only $5. Just tell us your proposition. Business Consultants, 28 E. First, Hutchinson, Kansas.

INCH Display Advertisement Fifty Magazines, Year $24. Wood's Popular Services, Atlantic City, N. J.

27 BASIC Advertising Elements plus copy Progressive Mail Trade, 25 cents (Refundable). Direct Mail Service, Homewood 9, Ala.

20 WORDS $2.60. Circulation 234,000. Goodale, 37 Gardner, Vallejo, Calif.

W ADVICE

DRUNKENNESS Is a disease which responds to treatment. Medical skill plus human sympathy prove successful with liquor and drug cases. 60 years experience. Write for free booklet. P. S. Nelson, The Keeley Institute, Dwight, Ill.

THOROUGH testing will help you select the work you can do best. Test Bureau, Rutherford Preparatory School, Box 347, Long Beach 1, Calif.

ADVICE—Personal, social, educational, domestic, industrial, technical, psychological, confidential. Send dollar, Box 141, Nyack, N. Y.

DO you need advice? Confidential advice on domestic and personal problems $1.00. Lee Margolis, P.O. Box 5142, Philadelphia, Pa.

SEEKING new job or promotion in present one? Learn new accepted way of presenting applications and naming salary. Send for complete course today. $1.00 Prepaid. Apton Co., Box 716, Augusta, Ga.

2 AGENTS WANTED

SCHOOL Seniors—Sell classmates America's most beautiful, distinctive Graduation Name Cards. Positively highest commission. Largest selection. Lowest prices. Free cards and sample kit. Printcraft, 1423 E. Elm St., Scranton 5, Pa.

LICK After-war layoffs; Start own business; home, office. Booklet describing "Collection of 127 Tested Plans" free. Elite Co., 220 Grand St., New York.

GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G. Decatur, Illinois.

EXCELLENT Sideline for Printing Salesmen. Decalcomania Name Plates in small quantities. Also, make money applying Initials on Automobiles. Free Samples. "Ralco", X-164, Boston (18), Mass.

FREE Water and our concentrates makes flavors, lotions, shampoos. 72 products, labels, bottles furnished. Qualco, F-20030 Russell, Detroit.

FREE! Latest issue Opportunity Magazine. Salesman's Guide. Inspiring, constructive. Shows how to earn money selling for others or in your own business. Hundreds postwar opportunities. Send name and describe what you have sold or are selling. Illustrated copy sent Free. Opportunity Magazine, 620 N. Michigan, Dept. 18, Chicago 11, Ill.

BIG profits taking subscriptions for all magazines. Agents' Confidential Catalog listing over 2500 periodicals and complete starting supplies Free. Pines Subscription Agency, Flushing, New York.

START Your Own Business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world wide Industry. Write Rawleigh Co., Dept. C-U-PSC Freeport, Ill.

WAR Honor Scroll. All branches of service represented. 12 by 16. Space provided for name and photograph. Truly beautiful. Agents make big money. Sample 25c. E. Condon, Dept. 9, Upper Darby, Pa.

90c PROFIT each $1 sale. Sell permanent mothproofing solution to housewives, stores, agents. Experience unnecessary. Postal brings details. Kinford, Wayne 4, Penna.

UP to 100% profit selling friends sensational $1.00 All Occasion greeting card assortment. Costs you 50c up. Birthday, Baby, Gift Wrapping, Humorous, Scripture boxes 35c up. Extra bonus. Request $1.00 box on approval, free personal stationery portfolio. Special Offer. Elmira Greeting Card Co. M-72, Elmira, N. Y.

MAGIC cleaner and laundry soap deal. Hotter than a firecracker. Big profits. Sample Free. Uco, 5007 Irving Park, Chicago.

SELL New-Used clothing from home, auto, store. Mens suits $1.17. Leather Jackets 85c. Overcoats 62c. Dresses 17c. Ladies coats 38c. Other Bargains. Catalog Free. S & N, 565A Roosevelt, Chicago.

AMAZING New Zipper Shoe sells on sight. Big profits for salesmen. Leads line 200 splendid styles. Territories open. Get Free Sample Outfit. Write Consolidated Shoe, Dept. S-154, Chippewa Falls, Wis.

GOLD Lacquered Window Sign Letters. New Foils—Styles—Absolutely Beautiful. Free Samples. Atlas, 7941 Halsted, Chicago

SALESMEN—sell human necessities. Large profits. High repeats. Colloidal Products, Tampa 1, Fla.

SELL TO DEALERS. America's finest line Counter-Carded Novelties and Necessities. We show you how to make profits very first day. Highlander, Dept. 5C 4613 N. Clark, Chicago 40, Ill.

FASCINATING year 'round income building plan. Take easy orders from friends, fellow workers, church organizations for 10 fast selling greeting card assortments. Sell for $1.00 each—cost you 50c up. Extra bonus. Experience unnecessary. Request foremost $1.00 All Occasion box on approval, free Correspondence Notes samples. Special Offer. Bluebird Studios, Dept. 17-E, Fitchburg, Mass.

SELL Greeting Cards. Easy Money showing gorgeous All Occasion, Birthday, Religious, Humorous, Easter Box assortments, Wrappings, Stationery, Correspondence Notes. Special Offers. Experience unnecessary. Quick service. Request $1.00 Everyday Assortment on approval. Hedenkamp, 343 Broadway, Dept. PSM, New York 13, N. Y.

SELLS on sight. Beautifully hand painted novelties. Variety of samples $1.00. Plastex Products, 11-41 Manhattan Ave., Brooklyn, N. Y.

NEW year 'round extra money plan. Show friends exclusive greeting card assortments. Up to 100% profit. Request all Occasion $1.00 assortment on approval. Also show Birthdays, Social Notes, Gift Wrappings. Free sample Personalized Stationery. Thomas Terry Studios, 139 Union Ave., Westfield, Mass.

ANY size picture reproduced on postage-size photostamps. 100 actual photos $1.50. Artcraft, 1600 Coney Island, Brooklyn 30, N. Y.

DURALUMIN cigarette lighters. Sample $1.00. Thriftmaster, Box 61, Times Sq. Sta., New York 18.

MAN, you'll like silvering mirrors, reflectors! Plating tableware. Making sparkling chipped glass nameplates. Outfit Prices. Sprinkle, Plater, V90, Marion, Ind.

DOUBLE-DUTY shopping bag. Zips open. Instantly changes from small to large size. Lightning seller. Samples sent on trial. Kristee, 123, Akron, Ohio.

THERE'S Profit in taking magazine orders from neighbors and friends. Helps furnished, liberal commissions. Voluntary repeat sales, wholesale catalog free. Write today! McGregor Magazine Agency, Dept. PS-6, Mt. Morris, Ill.

STAINLESS steel watch bands, sample $1.00. Dozen $12.00. Engineering, 1155 So. Kenmore, Los Angeles 6, Calif.

MAKE Money At Home By Mail. Sell Books. Send 3c stamp for complete setup. Business Plans Foundation, P.O. Box 56-M, New York 10, N. Y.

MECHANICAL drawing instruments—Veeco, 4 piece, compact, precision set, brand new in lined case, value $12.50. Special, $7.25—Deitzgen 11 piece set, $10.00—Charvos 9 piece set, $8.50. Army surplus slide rules, slightly used, 75c each. Hull Auto Compass, for accurate road direction, brand new, $2.50. Forward money with order. No C.O.D. shipments. Public Sport Shops, 13 S. 16th St., Phila., Pa.

200 MONEY Making Ideas, Plans, Rare Formulas, Schemes. Folio Free. Formico Co., Box 572, Dayton, Ohio.

Copyrighted material

POPULAR SCIENCE OPPORTUNITIES

BEAUTIFUL Gold Embossed Honor Scroll for Veterans. Most beautiful service memento Anywhere, regardless of price. Sells on sight for $1.00—Up to 85c profit to agents. Three saleable samples $1.00 postpaid. Particulars Free! Levine's, Box 15-A. Boulevard Station, New York 59, N.Y.

BUILD Year Round Lifetime Business, sell everyday necessities to stores, institutions, industrial plants, homes, etc. Easy repeats. Excellent profits. Great cooperation. Become territory distributor. Investigate. Lytle Supply Co., Ave. 12, Fredericksburg, Ohio.

SCHOOL Seniors: Sell classmates superb Craftcards for super profits. Write Craftcards, Box 235 (AH), Pittsburgh, Pa.

SELL individual belts, buckles. Over thousand emblems to choose. Fast money maker. Repeat business. Write today. Special outfit offer. Hook-Fast Specialties, Box 1425. Providence, R. I.

$1 STARTS you in business. Sell DeLuxe five fold ties, 100% wool interlining. Costs you only $7 per dozen, you make $5.00 dozen. Send $1.00 for special introductory offer two five fold ties. Catalog complete line Free. Philip's Neckwear, 20 W. 22nd St., Dept. K-52, New York 10.

PICTURES for Framing. Samples and Lists 10c. Curtis, Box 1916 B, Denver 1, Col.

WHOLESALE: Razor Blades, Laces, Excello, Texide, Silvertex and others. Write for prices and information. National Sales Company, Dept. 114 221 Page St., Flint 5, Mich.

SILVER Plating Liquid. (NuSilver trade mark). Apply with a cloth. Simply rub-on with a saturated cloth, dry-off and buff-up bright with a dry soft polishing cloth. All done in 1 minute. It cleans, silverplates and polishes from the one application. Easily done at home or in the office by anyone. NuSilver Plating Liquid is a more than 50% (½ plus) genuine U. S. Government Treasury Department Domestic Silver solution, 1000 Fine (pure Silver), Sterling. It renews all Sterling and plated silverware. It also silverplates onto brass, copper, bronze, zinc nickel-silver, german-silver, and some other composition metals. Over 100 uses listed to-date. NuSilver is a permanent lasting finish. Won't wash off. Won't brush off. Won't boil off. Once applied as directed it is there to stay. NuSilver Plating Liquid is a widespread and intensive seller. Working sales distributors are wanted for areas not now being worked. Easily sold to merchants in dozen lots by a sales set-up which furnishes free printed guarantees, printed advertising leaflets and one store counter display card for each one dozen, any kind of a store or business place can sell NuSilver. Any kind of an average distributor-Salesman can sell NuSilver. You sell, deliver and collect your big cash profits as you work. Details by letter-mail. For U.S.A. territory only. Can Sell both wholesale and retail, and to jobbers or any way you like. NuProcess Products Laboratories, Dept. 211, Aurora, Ill.

JUST Out! History of World War II. Huge volume. Popular price. Authentic text. Official Photographs. Big profits. Riverside Book Co., Iowa Falls, Ia.

WE pay you $25 for selling fifty $1.00 assortments Birthday, All Occasion cards. Tremendous demand. Sell for $1.00—your profit 50c. It costs nothing to try. Write for samples. Cheerful Card Co., 90 White Plains, N. Y.

SELL "Petite Picture Notes." Something really different in greeting cards. Sample free. Dunbar Cards, New Brunswick 21, N. J.

SCHOOL Seniors! Your postal will bring our wonder, Kwick-Sell Cardalog of popular Graduation Name Cards. Biggest profit! Only firm giving free souvenir chest and Card Case. Don't miss out! Hurry that postal! Craftcards, Box 235(M), Pittsburgh 30, Penna.

BLACKLITE Experimental Kits—Five Colors Fluorescent Lacquer and Ultra Violet Lamp all for Five dollars. Keese Engineering Co., 7354 Santa Monica Blvd., Hollywood 46, Calif.

MAKE up to $25 a day selling advertising specialties. Details free, Steele Adv. Service, Box 596, Richmond 5, Va.

$3 FIRE Extinguisher sells wholesale or direct. "Fire Killer", Zone 1, Syracuse, New York.

AT Last! Something new and sensational in Everyday Greeting Cards. Gorgeous "Glass Bead" designs never before offered. Get orders fast. Up to 100% profit. Other fast-selling box assortments. Samples sent on approval. Write today. Puro Co., Inc., 3041 Locust, Dept. 641-C, St. Louis 3, Mo.

EASY profitable sales, consumer, retailer, inexpensive fire extinguisher. Fi-Rout, Box 1154, Paterson, N. J.

NO more worries about Flat Tires! Ernie Airline Tire Inflator! Send $1. Distributors Wanted, Box PS3145, Euclid 17, Ohio.

25 WAYS to make money with Luminous Paint (Shines in the dark). Rush only 25c for profitable details and luminous color sample. Lite-Saver, 97B, Saybrook, Conn.

25c WILL Bring You Hundreds Of Propositions from firms who want agents. Tired of answering ads? Then try our way. Kakay & Co., Box 1032, Tampa 1, Florida

BIG Profits Packaging, Distributing, amazing cleaner. Steady repeater. Everything furnished. Sample 25c. Linnell Co., Box 1720, Cleveland 5, Ohio.

NEW 1946 Greeting Card Box Assortments. Easter, Mother's Father's Day Cards. Stationery, Gift Wrappings, Novelties. 4154b Fifth St., Philadelphia 40.

EXTRA Profit opportunities selling Highlander Counter-Carded novelties and necessities to Dealers. Be a Wholesaler, using Tested Success Plans. Write for Territory. Highlander, Dept. 5B, 4613 N. Clark, Chicago, Ill.

SALESMEN—Would you like to make up to $75 cash commission weekly? Address Shutt Co., 243 E. Ohio St., Indianapolis 4, Indiana.

JOKES, Novelties. Wholesale. Hundred pieces dollar. Pauly, 2295 Concourse, New York City 53.

TYPEWRITER Ribbons Wholesale; $3.80 Dozen! Galluzzo, 923 Milton, Pittsburgh 18, Penna.

POWERFUL Mile Stretcher! Increases mileage! Increases power! Increases Bank-Accounts! Tremendous Profits! Thermopower, Peoria 4, Ill.

3 AIR CONDITIONING & HEATING

RAISE steam with low fire $1.00. Dufour, 47 Sheridan St., Lakeport N. H.

DEALERS and Installation men to sell and install gas conversion burners. Large profits. Peerless 4320, Sheridan, Lincoln 6, Nebr.

CONVERSION Gas Burners. O. A. Moore Equipment Co., Lincoln 6, Nebraska.

4 AMERICAN POLICE, JU JITSU

DEADLY Judo-Fiercest Fighting Technique. Jitsu, Wrestling, Foot-Fighting, Police tactics. Complete course (186 Photographs). Special $1.00. Variety House, Box 46-AD, Wall Station, N.Y.C.

DEFEAT a boxer. Secret ju-jitsu defense. Complete instructions 25c. Dr. Malcolm Smith, 1104 Union Ave., Montreal 3, Canada.

5 ANTIQUES, RELICS, INDIAN GOODS

SWORDS, rapiers, daggers, pistols, armor; illustrated catalog, 25c. Robert Abels, 860½ Lexington Ave., N. Y.

LUCKY Stones—Polished Chiastolite crystals used by Indians for good luck charms—Only 50c. R. Pullen, 40 Magnolia, Santa Cruz, Calif.

440 ANTIQUE Firearms: 4,000 Bargains: Coins, Indian Relics, Cartridges, Minerals, Rifles, Swords, Fossils, Flintlocks, Carbines. Catalog with Photographs 25c. Heike, Wenona, Ill.

4 FINE perfect Ancient Arrowheads $1.00. 4 perfect tiny bird arrowheads, $1.00. List Free. Lear's, Box 569, Galveston, Texas.

RR ARCH SUPPORTS

BIG Profits Manufacture custom arch supports. Julis Corssen, 2638 Geyer, St. Louis 4, Mo.

DD ASTROLOGY

FREE! 3 questions answered with solar horoscope. Send birthdate 25c. Professor Golliday, L-1514 Long, Columbus, Ohio.

6 AUTHORS SERVICE

1946 MARKET Folios! 100 Paying Markets for Humor & Cartoons—25c. 100 Paying Markets for Poems & Greetings—25c. 100 Paying Markets for Fillers & Short Items—25c. Tips, instructions included. Typing, Revision, Criticism Services. Bierman, 185 Lexington Ave., New York 16, N. Y.

IMMEDIATE Income for Writers, beginners or advanced. Learn how to write and sell short personalized stories. Profitable waiting market. Send stamp for literature and proof. S. Snyder, Box 4907-W, Philadelphia 19, Pa.

WIN fame, success, security writing short stories, newspaper features. Easy-to-learn course shows you how. Exclusive details yours for a penny postal. Writer's Institute, 4-P So. 15th St., Philadelphia 2, Pa.

7 AUTOMOBILES

AUTOMOBILE Racing Book. Fifth Edition—Revised. Tells how to build dirt track bodies, frames, engines. Records, superchargers, rules, formula, plans, stock conversions, roadster racing, fast Fords. $1.00 postpaid; $1.15 C.O.D. Ray Kuns, Department 274, Madisonville, Cincinnati, Ohio.

SEE our ad under Motorcycles for midget racer and motorscooter bargains. Midget Motors Directory, Athens, Ohio.

CUSTOMIZE your automobile. Illustrated new restyling ideas, instructions, specific model changes by simple methods, $1. Speedwheel, Box 723-C, Arcadia, California.

PHOTOS famous race car drivers with their cars. Today's fascinating hobby for everyone. Present these pictures at races to be autographed. Experience new thrills. Pictures taken by Frank Smith famous retired race driver. Special offer, assortment 7 famous drivers size 4x5—$1.00 including free autographed Ted Horn photo. Photo Ted Horn only 25c postpaid. Frank Smith, Franklin Ave., Midland Park, N. J.

PHOTOGRAPHS, World's Finest Automobiles. List 10c. Box 1028, Minneapolis, Minn.

GARAGE doors, all types, controlled from dashboard. Complete "Build Yourself" plans $1.00, refundable. Vital parts now available. Kaytor Laboratories, Lynwood, Calif.

BUILD Midget Racer from castoff parts! Plans specifications, construction information, $1.00. Motor Supply, Box 1682-CS, Toledo, Ohio.

STEAM Car Scrapbook. Compiled by Floyd Clymer. Historical, authentic, amusing. Ads, photos, descriptions 250 early steam cars, with fascinating story by one-time world's youngest auto dealer. Postpaid $2.00. DeLuxe Cloth-bound $3.00. Clymer, 2125 W. Pico, Los Angeles 6, Calif.

HENRY Ford—His Life, His Work, His Genius. Wonderful new 384 page Ford History book. Unusual photographs, illustrations, early and late Ford cars. $3.00 Postpaid. Cloth bound edition $4.00. Clymers, 2125 W. Pico, Los Angeles 6, Calif.

NOW Ready! Floyd Clymer's Historical Motor Scrapbook Number Three, entirely different from Editions One and Two. Ads, photos, descriptions, specifications over 200 early autos, including Rolls-Royce, Owen Magnetic, Fordmobile, Revere, Ruxton, Cord, Roamer, Diana, Adler, Mercedes-Benz, Stutz Bearcat, Marmon, Stout, Flint, Lozier; steam and electric cars, many others. Motorcycle section includes early Cleveland, Henderson "6", Peerless, Wagner, Crocker, AMC, BMW, Excelsior, Ariel, Flanders, others. Pike's Peak races, many interesting incidents early automotive days described. Profusely illustrated. Continues Floyd Clymer's interesting autobiography. $1.50 postpaid; De Luxe Clothbound, $2.50. (Editions One and Two also available at these prices.) Clymer, 2125 W. Pico, Los Angeles 6, Calif.

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JET Impulsion now for automobiles. Complete installation instructions—$1.98. Wayne Engineering, Greenville 2, Ohio.

INTERESTING, Educational, illustrated English "Motor" magazine on foreign automobiles. 50c postpaid. Clymer, 2125 W. Pico, Los Angeles 6, Calif.

SENSATIONALLY easy to build inexpensive midget two-passenger Jeep from readily available materials! Large working plans, construction information, $1.00. Universal, 2671 Algonquin, Toledo, Ohio.

8 AUTO SUPPLIES & EQUIPMENT

HAVING Car Trouble? New, Used, guaranteed auto, truck parts save money. Transmission specialists. Describe needs; immediate reply. Victory, 2930¼ No. Western, Chicago 18.

NEW miracle motor fuel cuts driving and engine repair cost in half! Made by all major oil companies. Usually half price of gasoline! Will not form carbon, dilute oil. 1946 trucks coming equipped to utilize this fuel! Practically unknown, tremendous opportunities exist now! Hand book containing complete copyrighted information one dollar, or order C.O.D. Money back guarantee! Alberts, Box 492, Alhambra, Calif.

1000 MOTORISTS Needed to make gas savings test. Up to 30% savings. For trial test offer write Vacu-matic Carburetor Co., 7617-1267. W. S. State Street, Wauwatosa, Wis.

CARBURETOR repair kits for most popular cars and tractors. State year make and model. Carburetor Service, 600-B La-Prairie, Ferndale 20, Mich.

BATTERY charger from scraps. Simple, reliable. Plans 25c. McMenemy, Box 3182, St. Paul 1, Minn.

WHIRLGAS Turbinator, $3 carburetor amplifier, increases mileage, power. Universities verify. Auto make, year required. John Hanley, 5719 Loraine, Detroit 8, Mich.

AUTO parts for all autos and trucks. Trans., motors, differentials, fenders, carburetors. Also Body Parts. Security Auto and Truck Parts, 1941 BP Eddy, Chicago 13.

OIL Pumping Motors—Brought Back to Normal without Ring Job. Write for Particulars. Joe Mullner, Box 3102, I, St. Paul, Minn.

9 AUTO TRAILERS

BUILD your own Trailer! Save Money! Have every feature you want! Plans for House, Sport, Camp and Utility trailers. Catalog describing 9 models 10c. (15c in Canada and overseas) Jim Dandy, Box 125-B, Wausau, Wisconsin.

10 AVIATION

PROPELLERS for airplanes, ice-snow sleds, air boats, etc. Literature 5c. Banks Propellers, R.F.D. 7, Ft. Worth, Texas.

SEND 25c for War-Bargain catalogue of used airplanes, located everywhere, some probably near you. (35c by first class mail). Used Aircraft Directory, Athens, Ohio.

BUILD and fly your own motorcycle powered monoplane at home. Easy to build, short run takeoffs, sweet plane to fly. Tested plans, guaranteed, $1.00. Order Today, Now. Aerotech, Dept. 60, Dearborn, Mich.

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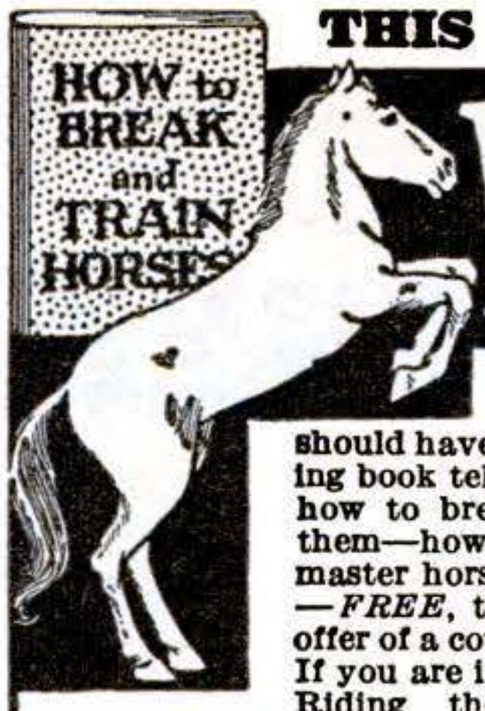

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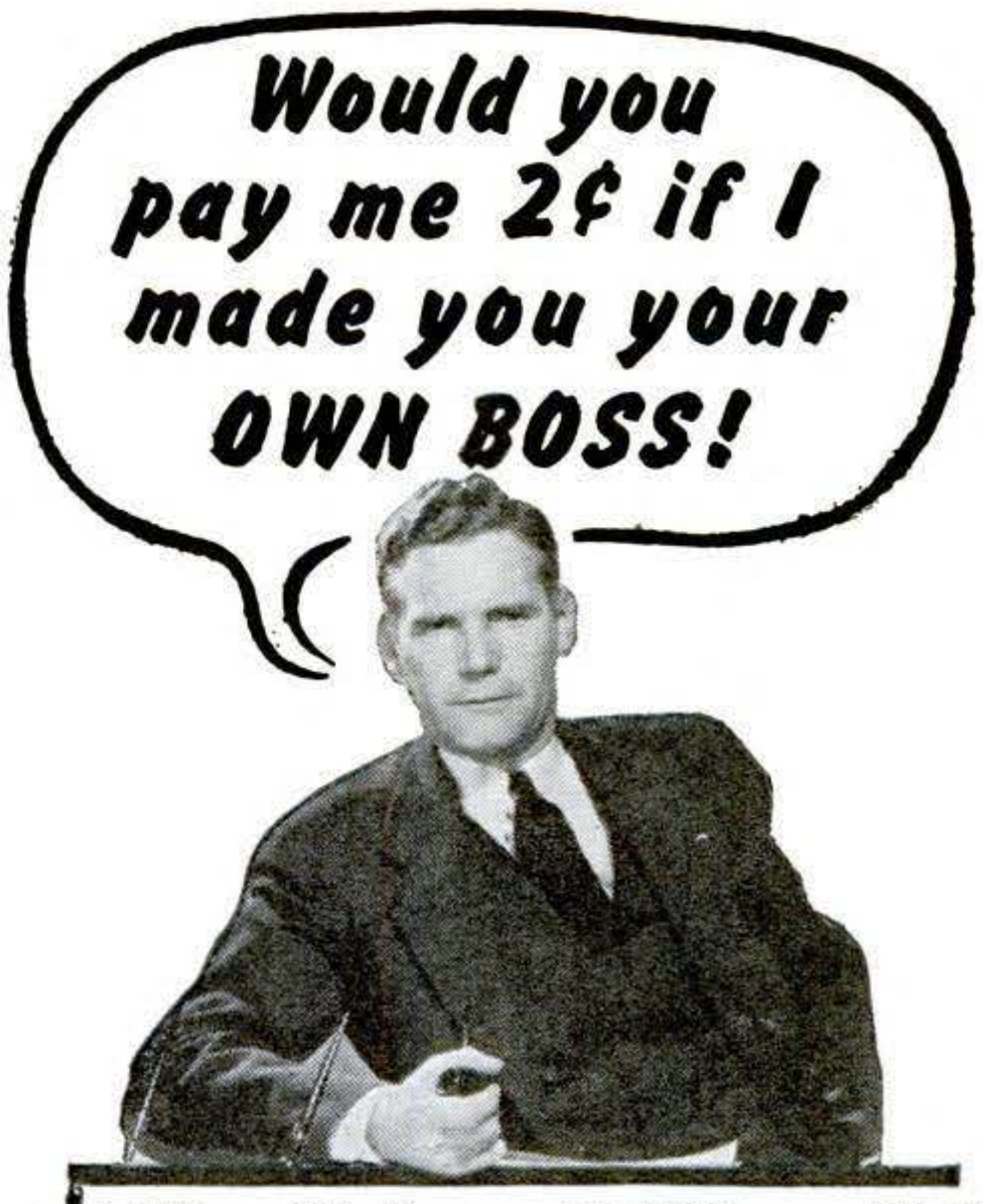

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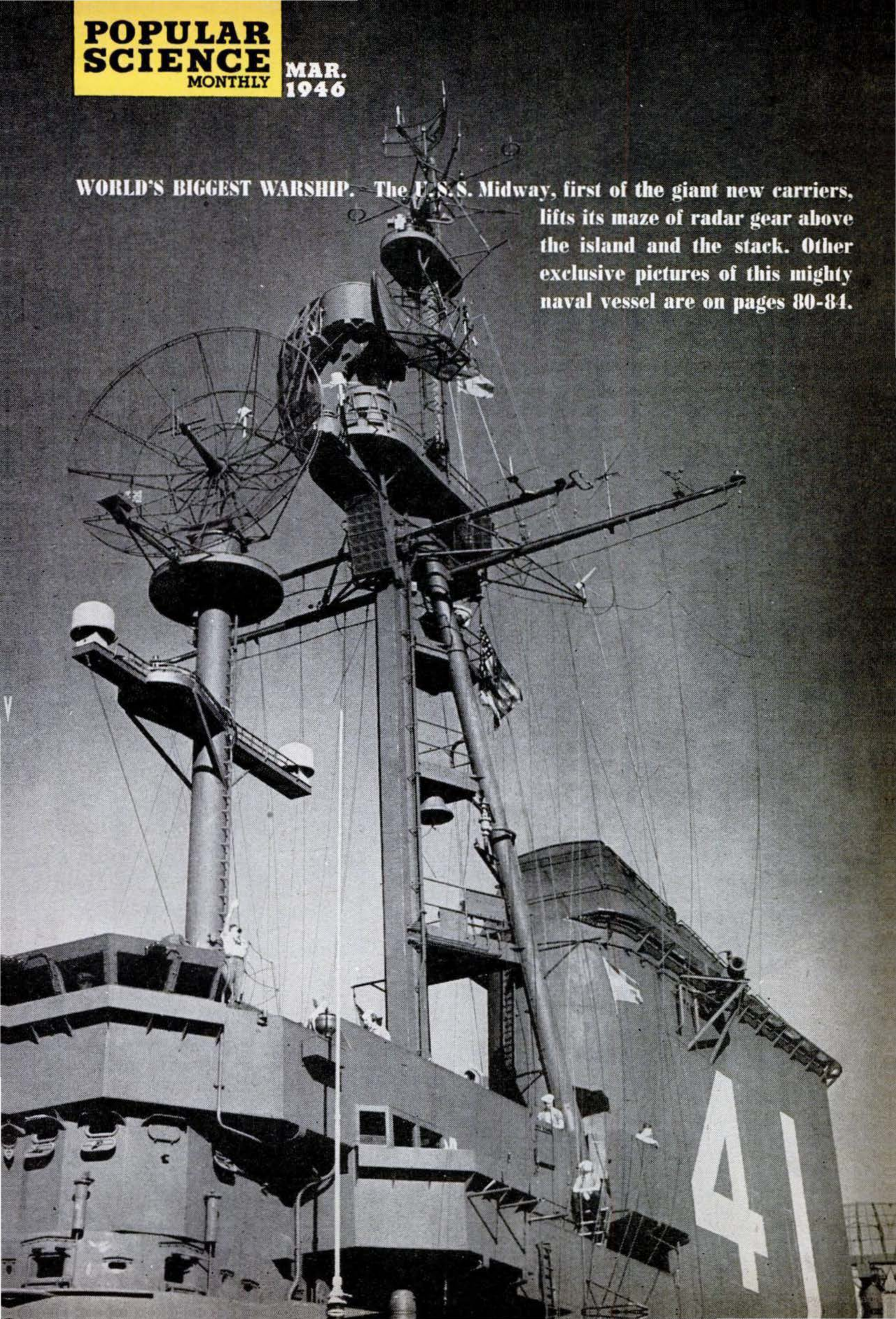
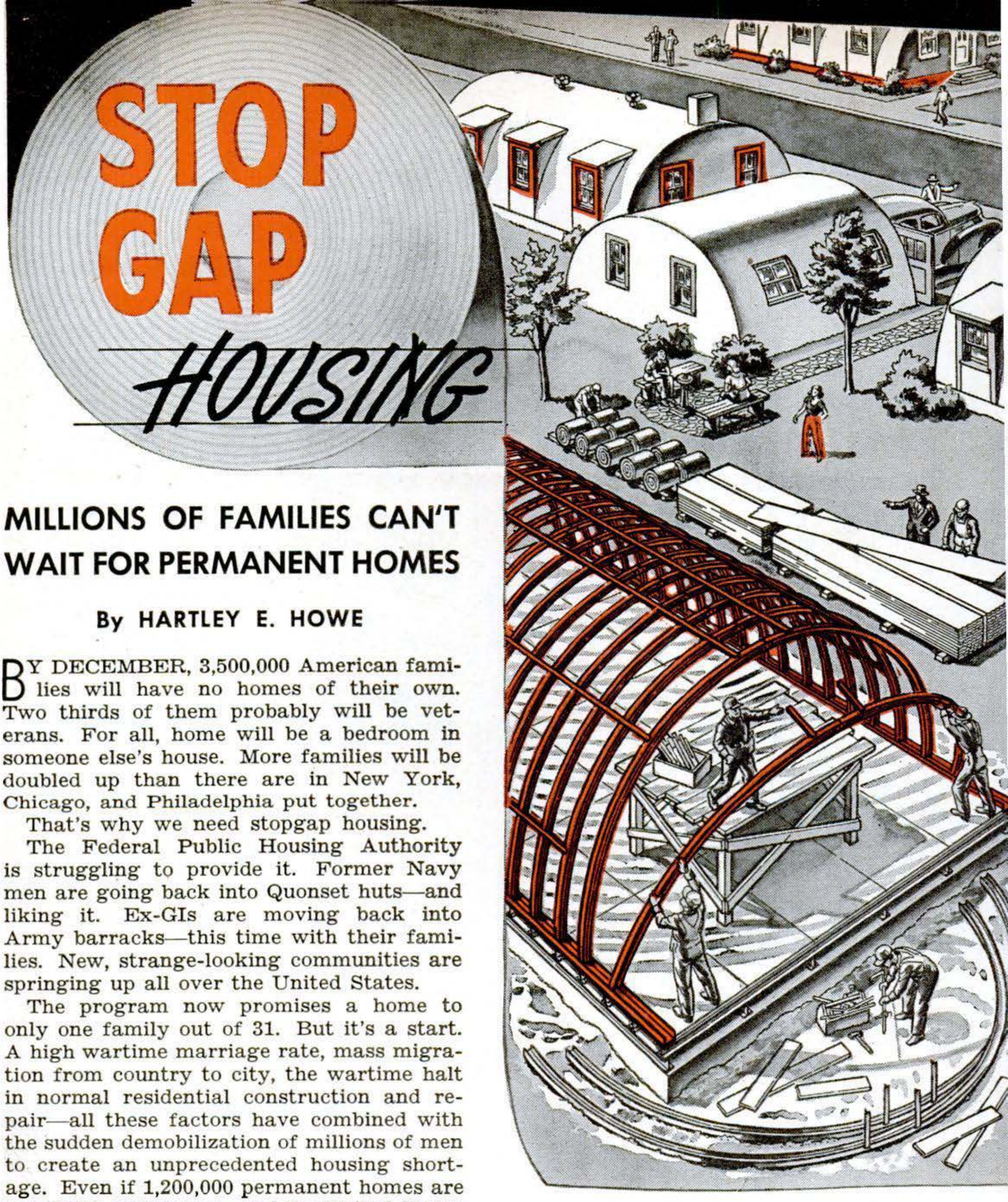


WORLD'S BIGGEST WARSHIP. The U.S.S. Midway, first of the giant new carriers, lifts its maze of radar gear above the island and the stack. Other exclusive pictures of this mighty naval vessel are on pages 80-84.

STOP GAP HOUSING



MILLIONS OF FAMILIES CAN'T WAIT FOR PERMANENT HOMES

By HARTLEY E. HOWE

BY DECEMBER, 3,500,000 American families will have no homes of their own. Two thirds of them probably will be veterans. For all, home will be a bedroom in someone else's house. More families will be doubled up than there are in New York, Chicago, and Philadelphia put together.

That's why we need stopgap housing.

The Federal Public Housing Authority is struggling to provide it. Former Navy men are going back into Quonset huts—and liking it. Ex-GIs are moving back into Army barracks—this time with their families. New, strange-looking communities are springing up all over the United States.

The program now promises a home to only one family out of 31. But it's a start. A high wartime marriage rate, mass migration from country to city, the wartime halt in normal residential construction and repair—all these factors have combined with the sudden demobilization of millions of men to create an unprecedented housing shortage. Even if 1,200,000 permanent homes are now built every year—and the United States has never built even 1,000,000 in a single year—it will be 10 years before the whole nation is properly housed. Hence, temporary housing is imperative to stop that gap.

So far there are seven different kinds of temporary housing available. All are wartime varieties that have been declared surplus and are being distributed by the Federal Public Housing Authority for the use of veterans. FPHA pays for dismantling the buildings, shipping them to new locations, and re-erecting them. The applicant—a college, municipality, or other nonprofit body—must provide the site, streets, and basic utility installations, as well as the management and maintenance expenses. The applicant also agrees to remove the temporary buildings after the emergency has passed. No profit is permitted on the rental of the houses; any surplus remaining after operating expenses must be turned over to the United States Treasury via FPHA.

The Navy's contribution to the stopgap program is the familiar Quonset hut, used by the services from the tropics to the Arctic. The armed forces bought 155,000

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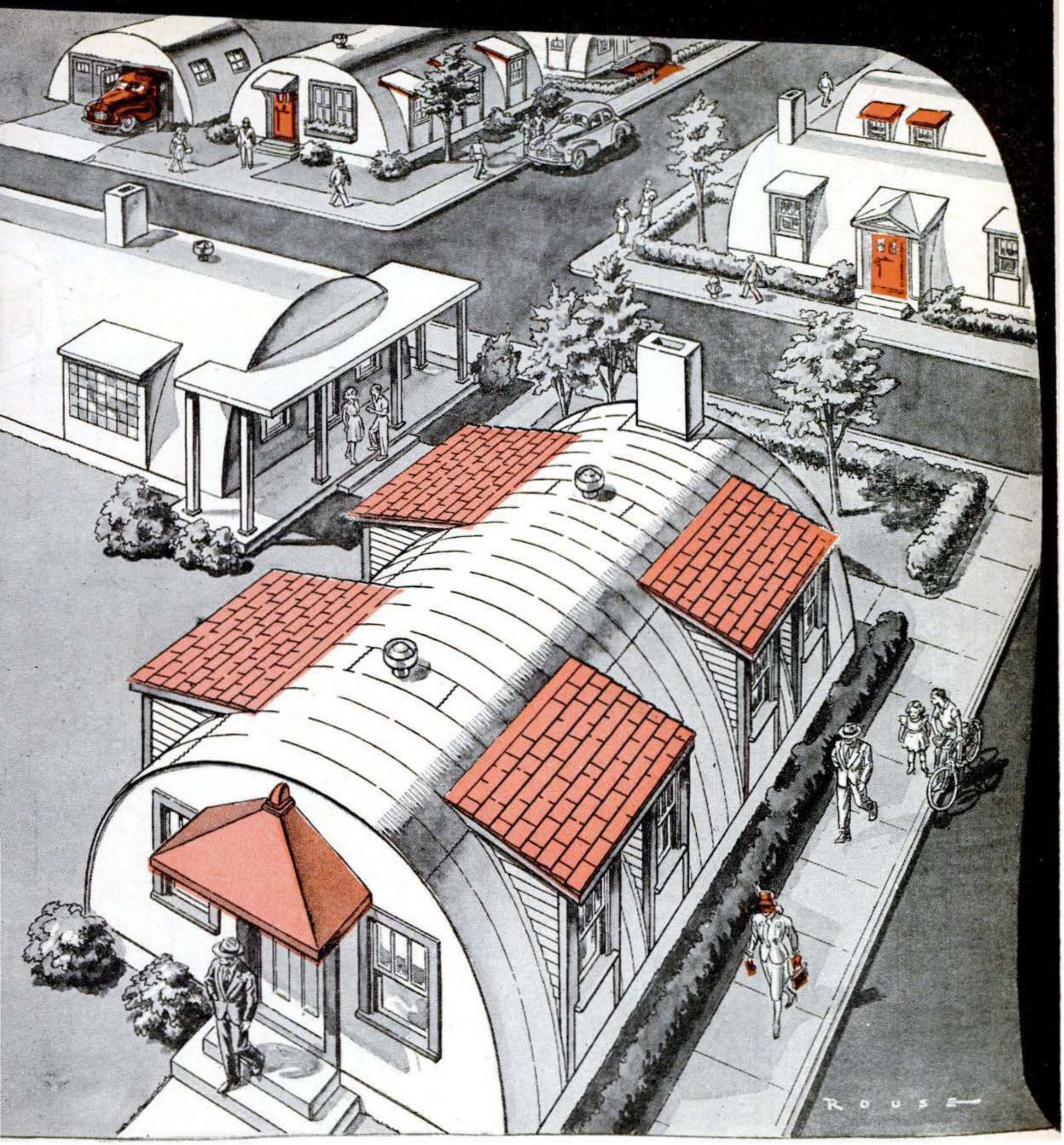

of these during the war, but 85 percent went overseas and only 5,000 of the remainder have been released as surplus. The veteran who moves his family into one of them will find it very different from his rough quarters overseas. The surplus units are all the 20- by 48-foot type used by the Navy itself to house 6,000 families of men on temporary duty at home bases. Each Homoja hut (compounded of the names of Admirals Horne, Moreell and Jacobs) is completely lined, insulated and floored, and divided into two apartments. Each apartment has two 12- by 8-foot bedrooms, a living room, small kitchen area, and shower bath. Such homes, including household equipment and utilities, cost the Navy between $3,000 and $3,300 a family and rent for $1 a day.

Army men will also find familiar buildings in the stopgap program. Surplus barracks, many of the one-story type, are being called back to active duty for veterans' housing. A 30-man barracks can be divided into three apartments, each with two bedrooms, kitchen, living room, and bath. Unlike the Quonset huts, these buildings are not de-

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Six thousand families, two to a 20- by 48-foot Quonset hut, live in the Navy's Homoja villages. This hut was named in honor of Jefferson Rahill, seen in his carriage.

mountable. They must be ripped apart by power saws and then nailed together again at the new site, but an outside sheathing of shingles or clapboards makes them attractive.

Five other types of stopgap housing were developed by the Federal Public Housing Authority for war workers in congested production centers. Congress has provided $191,000,000 to pay for moving 100,000 of these units, no longer needed for war workers, to new sites.

Temporary family dwelling units, which come in one-story and two-story sizes, are of light frame construction, covered with such materials as wallboard, plywood, and gypsum board. Already divided into family units, they require no interior conversion. They must be cut into panels for shipment to new sites.

Portable shelter units look like overgrown tourist cabins. Each shelter, holding a single family, has either one or two bedrooms.

War dormitories, either single- or double-storied, were planned for workers without families, each man being allotted a single room. Some buildings, especially those used for college housing, will probably be left this way for single veterans. Many, particularly the one-storied type, will be converted for family use, a two-bedroom apartment taking the place of six individual rooms. Each building must be panelized for shipment.

FPHA built 321,000 of these three types of building, of which more than 35,000 have now been put into use again for veterans.

Two types of trailers are also available. The standard variety is a conventional auto trailer, measuring 8 by 22 feet and housing three people. The expansible trailer is about the same size when folded up but blossoms out into a small house holding four or more persons. Both types are mounted on wheels for transportation, then hoisted on wooden horses at the new site. Thirty-five thousand trailers were used by FPHA in its war-housing program: more than 11,000 of these have been redistributed for stopgap homes. All are out on loan only and must eventually be returned to the agency.

The only other FPHA type that does not have to be cut up for shipment is the demountable house. This is a prefabricated, two-family, one-story building designed to be taken apart and re-erected wherever desired. Seventy-four thousand were built for war housing, but since the communities where they now are have first call on these houses it is uncertain how many will be available for stopgap housing.

These demountable homes must be paid for by the communities that acquire them, since, unlike all other emergency types, they are considered permanent residential units. The other varieties have a short life span; they were skimpily built to conserve scarce materials during the war. Only one tenth the framing lumber of normal buildings was used in them. Many units have no gutters or downspouts. Some have no bathtubs, only showers. Heating is mostly by small oil stoves. The number of cubic feet per occupant is frequently below modern standards.

But it is still better housing than many so-called permanent homes. Despite our much-vaunted American standard of living, a third of our nonfarm homes have no bathroom and 28 percent lack even a private flush toilet. Nearly four million need major repairs and of the remainder more than 3,100,000 have no running water. In contrast, stopgap housing seems homelike.

FPHA believes that much of its temporary housing will have a useful life even after it is scrapped as homes. From panels ripped from temporary buildings the agency has built full-size demonstration models of tourist cabins, roadside stands, chicken houses, ranch bunkhouses, garages, light-plane hangars, and other such structures.

Some city planners fear that stopgap-

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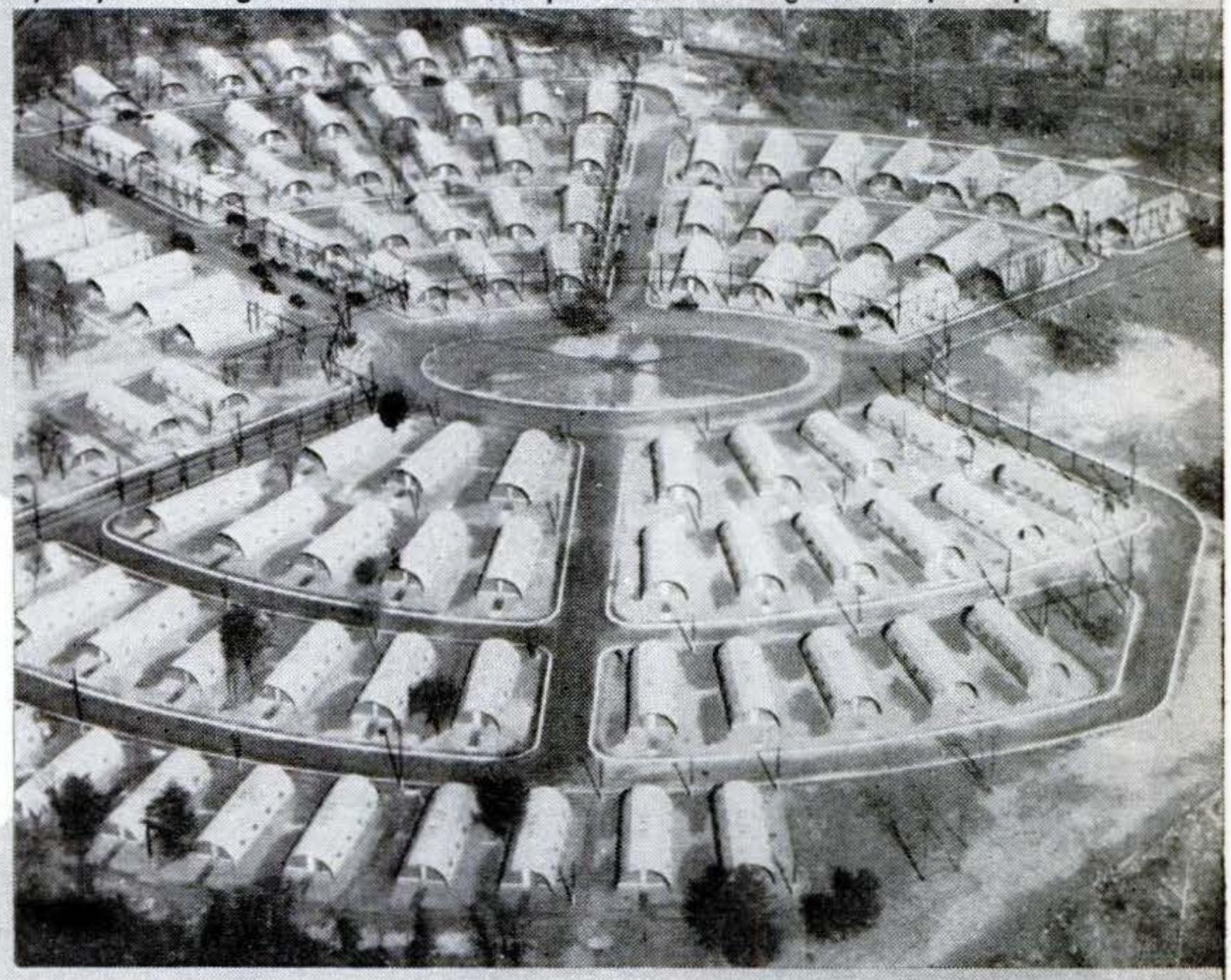
Before a Navy family moves into one of the Quonset-hut units, their new home is provided with basic furniture but has no rugs, pictures, or draperies. Kitchen is directly beyond living room.

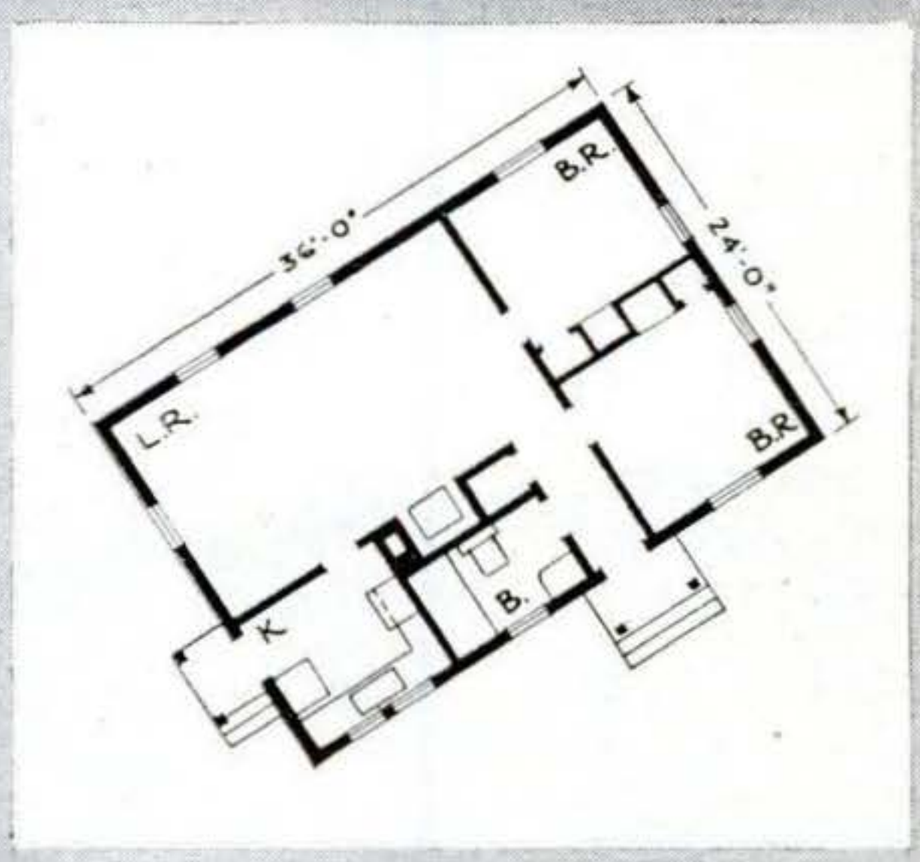
After Lt. Comdr. and Mrs. G. W. Rahill had moved into this hut, Mrs. Rahill soon made the place look livable. A half partition, screening the kitchen, has provided a feeling of more privacy.

Photographs by
WILLIAM W. MORRIS



In the Homoja village at Annapolis, steam heat is brought to the huts through overhead pipes. Separate huts are used for storage and for laundries.

The kitchen of a Homoja unit is as compact—and modern—as a ship's galley. Gas or electricity is used for cooking.



A 24- by 36-foot Quonset hut (they can be lengthened or shortened in increments of two feet) might be laid out like this.

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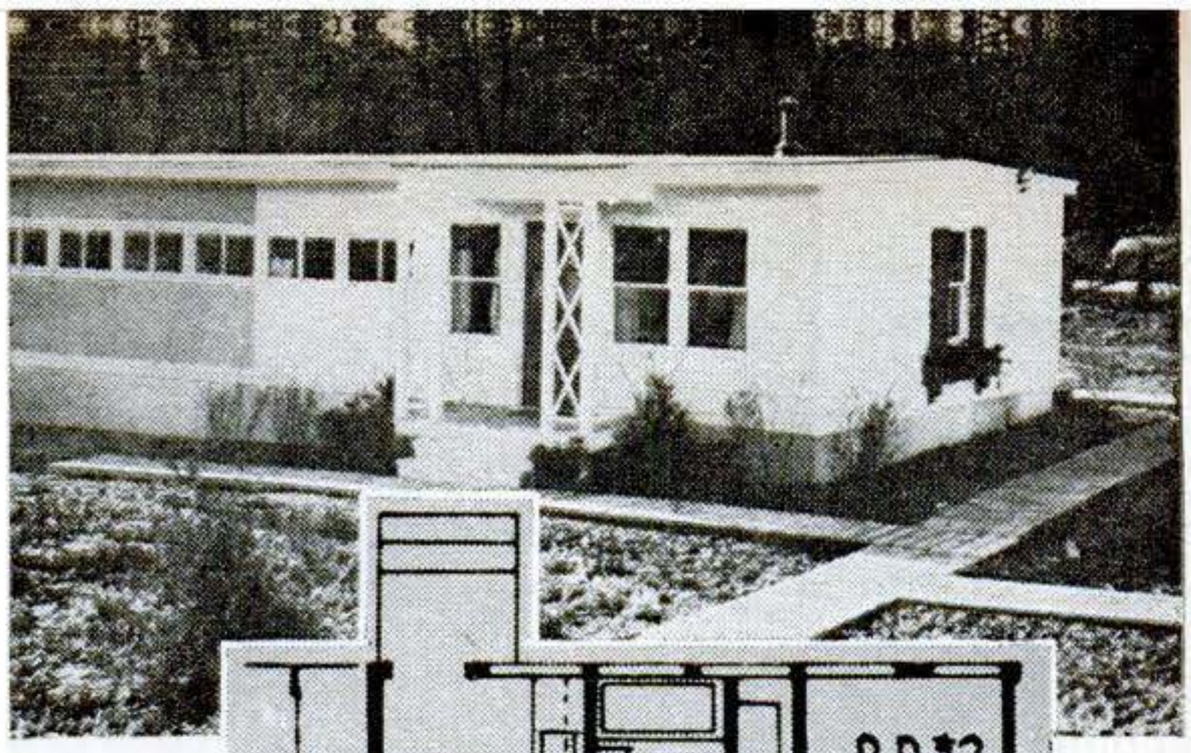
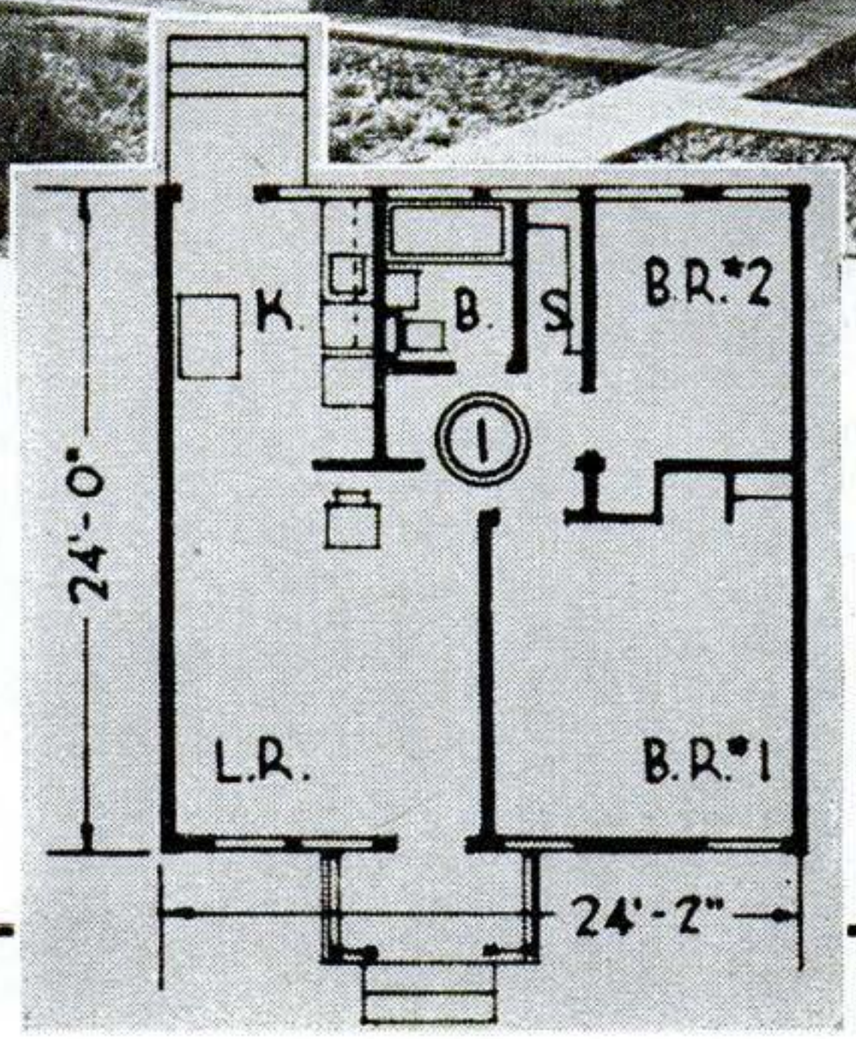


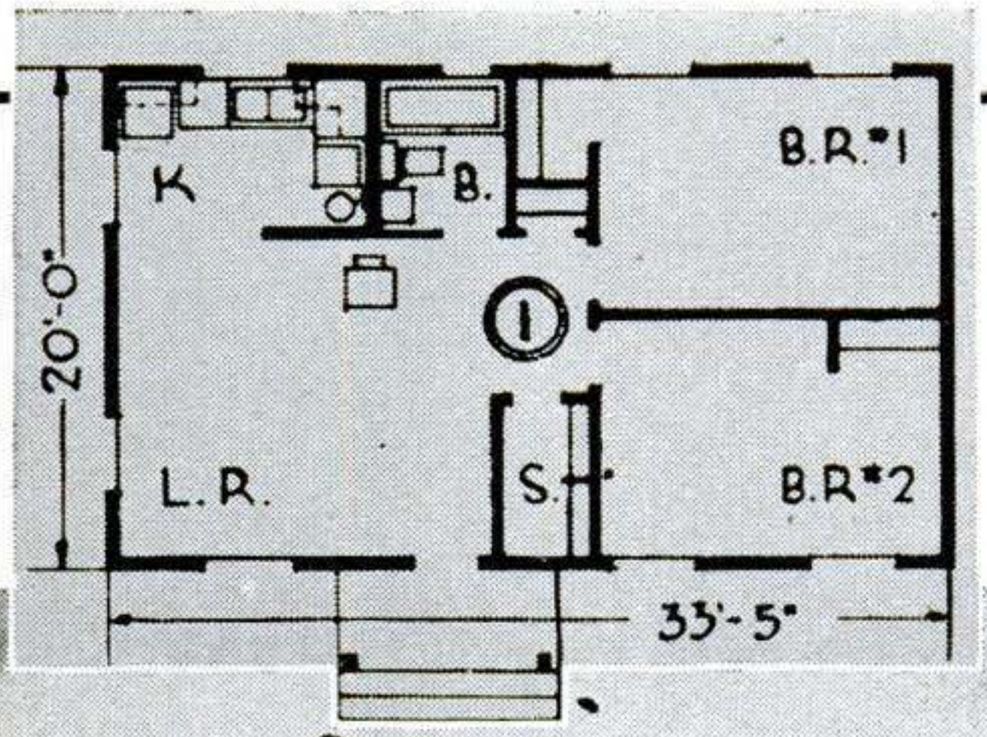


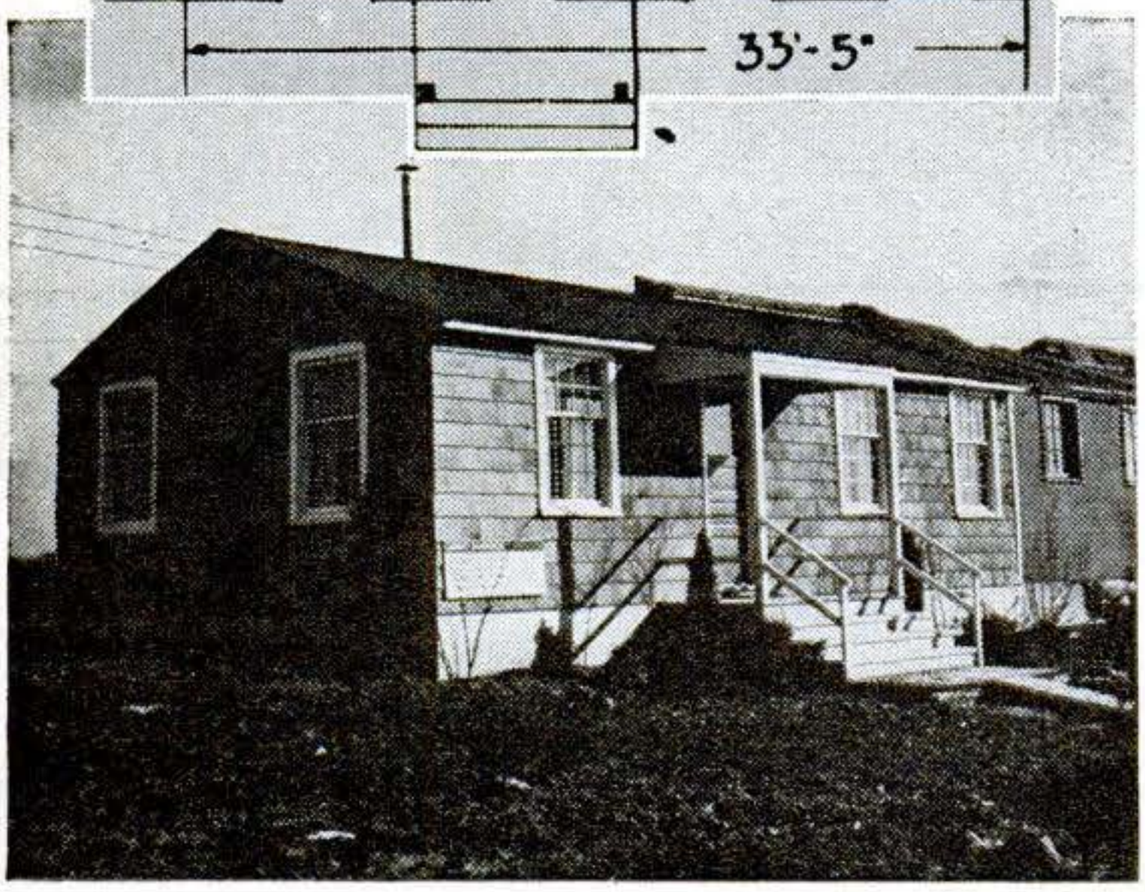
Six dwellings, each with two bedrooms like the one above and living room, kitchen and bath as well (right), are provided in converting a war-housing dormitory unit. Clapboarded portion of the structure in the photo at upper right reveals the size of each dwelling.

housing units will create more slums in the future. Many real estate interests contend that they will compete with private housing projects. Since the law requires that all governmental temporary housing be scrapped within two years of the end of the emergency, neither of these fears seems justified. This period may be extended wherever there is a continued shortage of places to live—but sooner or later every unit must be torn down.

What worries housing experts is how to expand the program. Few additional Navy Quonsets are likely to be declared surplus—the 85 percent shipped overseas cannot be returned, by law. Only a limited expansion of the war-housing conversion program is possible: there are only 430,000 temporary, demountable, and trailer units in existence and most of them are still occupied.

As for what the individual may do on his





Another wartime type of temporary housing now being converted to the needs of peace is the one-story Army barracks. Each structure of this kind can be made over into three dwelling units of four rooms and bath. Tasteful decorating gives even a makeshift house of this sort a cozy, homelike look.

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own hook, except for trailers the Quonset hut is the only kind of temporary housing a man may buy for himself. The skin and framing of the 20- by 48-foot hut are sold by the Stran-Steel Division of the Great Lakes Steel Corp. for $873 at the factory in Indiana. The buyer must erect the hut himself and provide his own insulation, lining, floors, partitions, and foundation. This permits any interior arrangement desired, including the use of the whole 20- by 48-foot area for one family instead of two. Stran-Steel, which turned out 9,000 Quonset huts a month for the armed forces, originally planned its postwar models for nonresidential use and provides only two windows in each end: the purchaser can either buy flat side windows, such as are used in the Navy units, or build regular dormers.

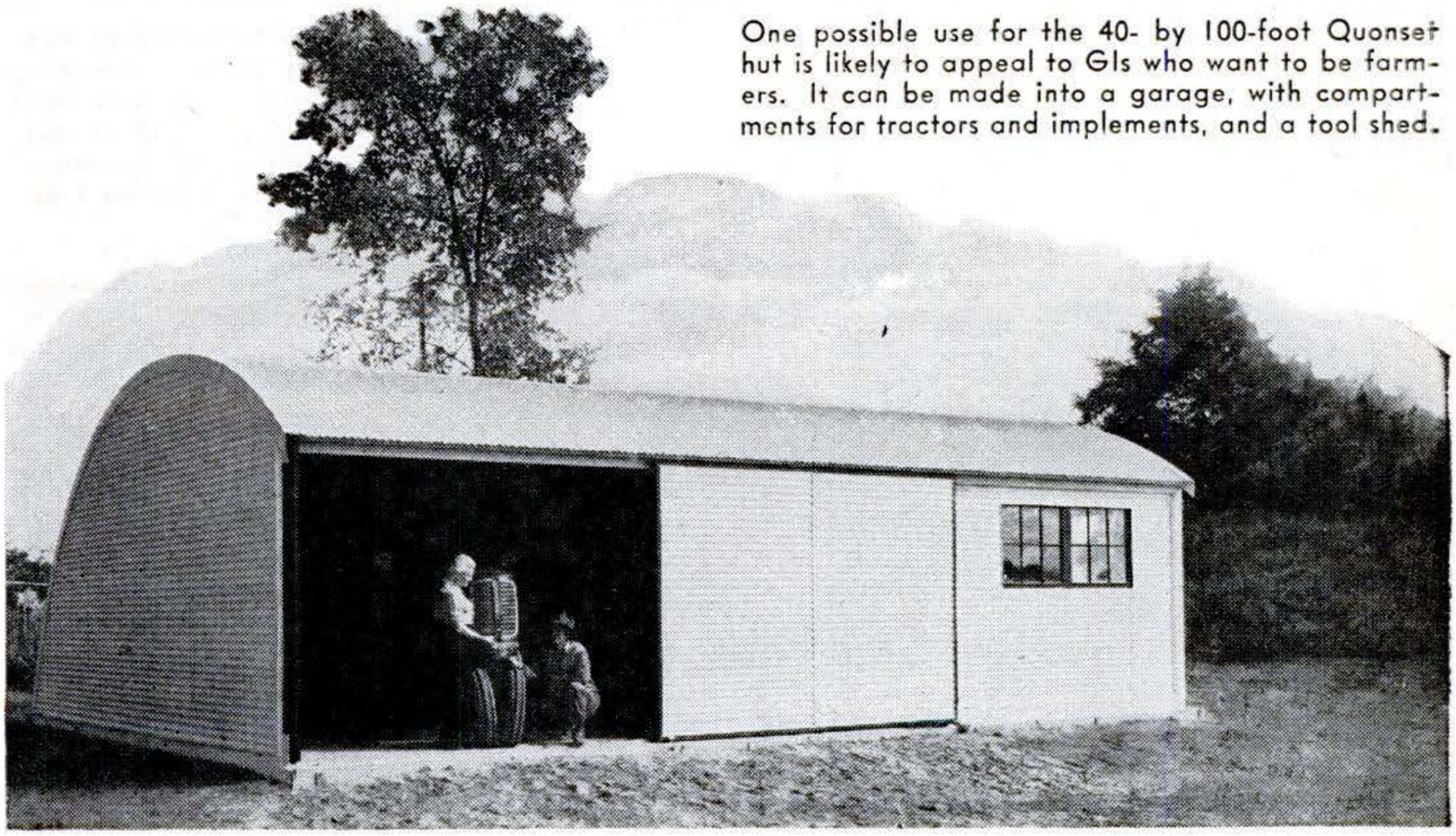
Erection of the units should not prove too much of a problem. The arch-rib steel framing, easy to stow, is designed so that the exterior sheets can be nailed directly to the supports. To permit this, each rib is made of two strips of steel with a "nailing groove," an irregular channel, between. Ordinary nails can be driven directly into this groove and are clinched automatically by the irregularities. A similar groove on the lower side of each rib permits the interior lining to be nailed on with equal ease.

Anyone planning to set up his personal stopgap-housing program with a Quonset hut or trailer on his own lot probably faces a lot of trouble, however. If he's in or near a big city he may have a cop with a summons as his first visitor. Many communities have strict zoning laws, which forbid the erection of any house costing less than a fixed minimum—usually far more than the cost of a Quonset. The building inspectors may prove another headache—lots of places rigidly limit building design to the conventional types and the arch-rib and steel skin of the Quonset are frequently out of bounds. Even if these hurdles are surmounted the would-be house owner may find a picket line across his front walk, for some labor unions refuse to work on unconventional types of construction.

The obstacles that face both governmental and private stopgap housing are very real ones. But to a nation that has just completed the job of housing 4,000,000 migrating war workers and their families—9,000,000 people—they are not insurmountable. Zoning acts, building regulations, union rules—are all man-made and can be suspended. In normal times many of these regulations are useful. These are not normal times.

The existing programs of re-using war housing must be expanded with additional funds. States and localities must be encouraged to erect their own temporary housing and not wait for Uncle Sam to do the whole job. And the individual must be given every opportunity to put up a temporary shelter for himself even if it means trampling on long-cherished rules of communities, builders, and workers.

It will be a hard job. The millions of veterans who are now flocking back to civilian life have just finished an even harder one: winning the greatest war in history. Will we admit that we lack the will or the energy to find them a place to live?



One possible use for the 40- by 100-foot Quonset hut is likely to appeal to GIs who want to be farmers. It can be made into a garage, with compartments for tractors and implements, and a tool shed.

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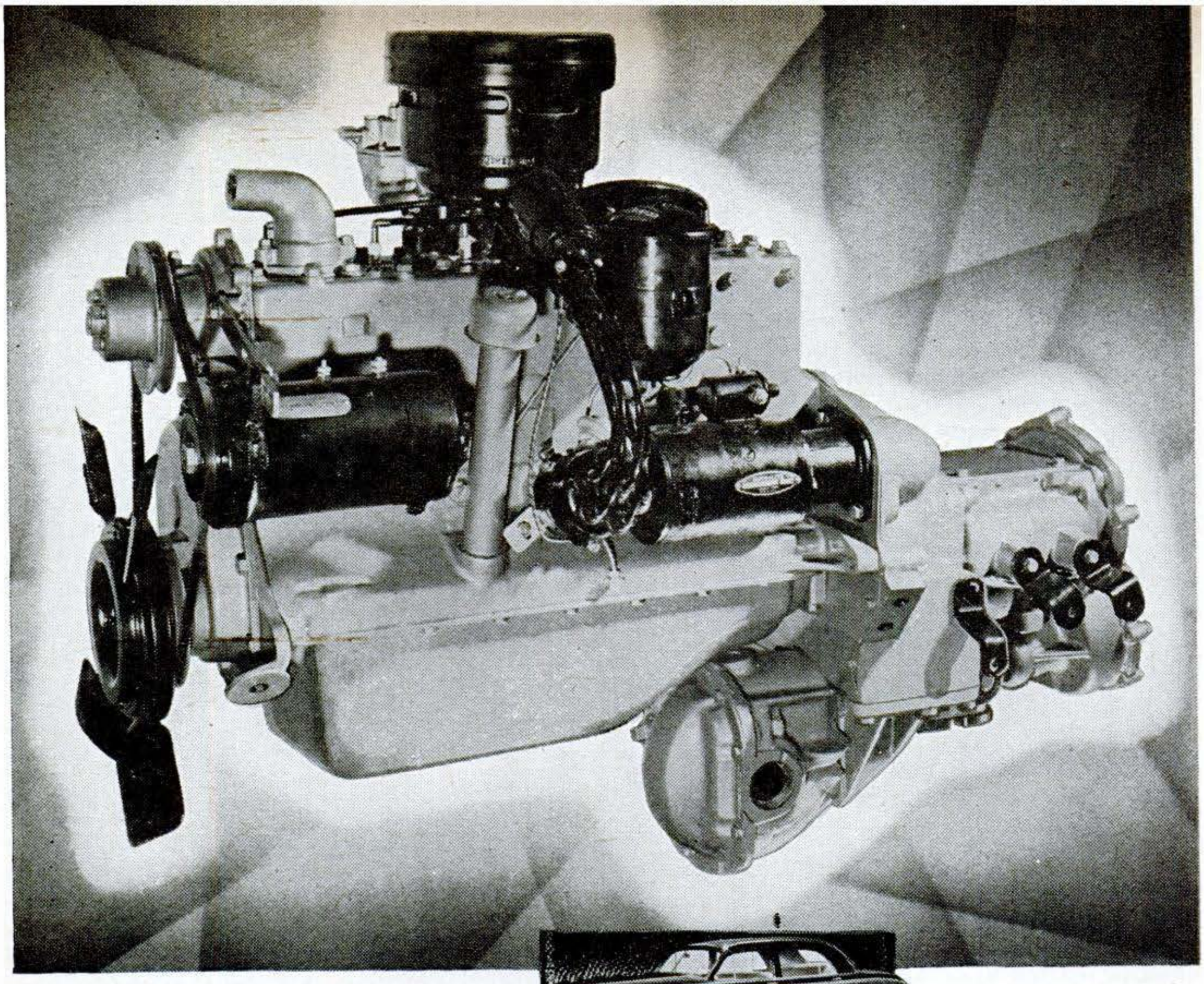

The unorthodox power unit of the Kaiser car. Unlike previous front-wheel drives, power comes from rear of motor.

Drawings by STEWART ROUSE

Inside the KAISER *Car*

FRONT-WHEEL DRIVE, TORSION-ROD SPRINGS NEW TO LOW-PRICE FIELD

TWO engineering features that make the new Kaiser car a radical departure in automobile design are front-wheel drive and torsion-rod springs. Both have been proved out thoroughly in Army equipment, from the jeep to the Pershing tank. While both have been taken over almost bodily from military cars, some alterations in design were necessary, of course, in adapting these features to modern passenger-car use.

The big, new idea in the Kaiser car is placing the motor forward of the front wheels. Power is taken off from the back of the motor assembly through a pair of helical gears. The drive shaft thus turns back upon itself, and goes forward under the motor to the differential. In military cars the drive is taken from the motor's front end.

Kaiser engineers claim that placing the motor in this position gives a more constant center of gravity over the driving wheels, overcoming the fault of too little traction on an upgrade. At the same time it gives the whole car a distribution of weight that does not change as much with varying numbers of passengers as it does in conventional automobiles.

The torsion-rod suspension system consists of a rod an inch and a third in diameter for each wheel. These rods run the width of the car. Twisting of the heat-treated bars is what gives the spring. The engineers declare that the torsion-rod spring provides a softer ride than helical or spiral springs. It is the simplest form of spring, has little bulk or weight, and lends itself particularly to the special front-end construction of this new automobile.

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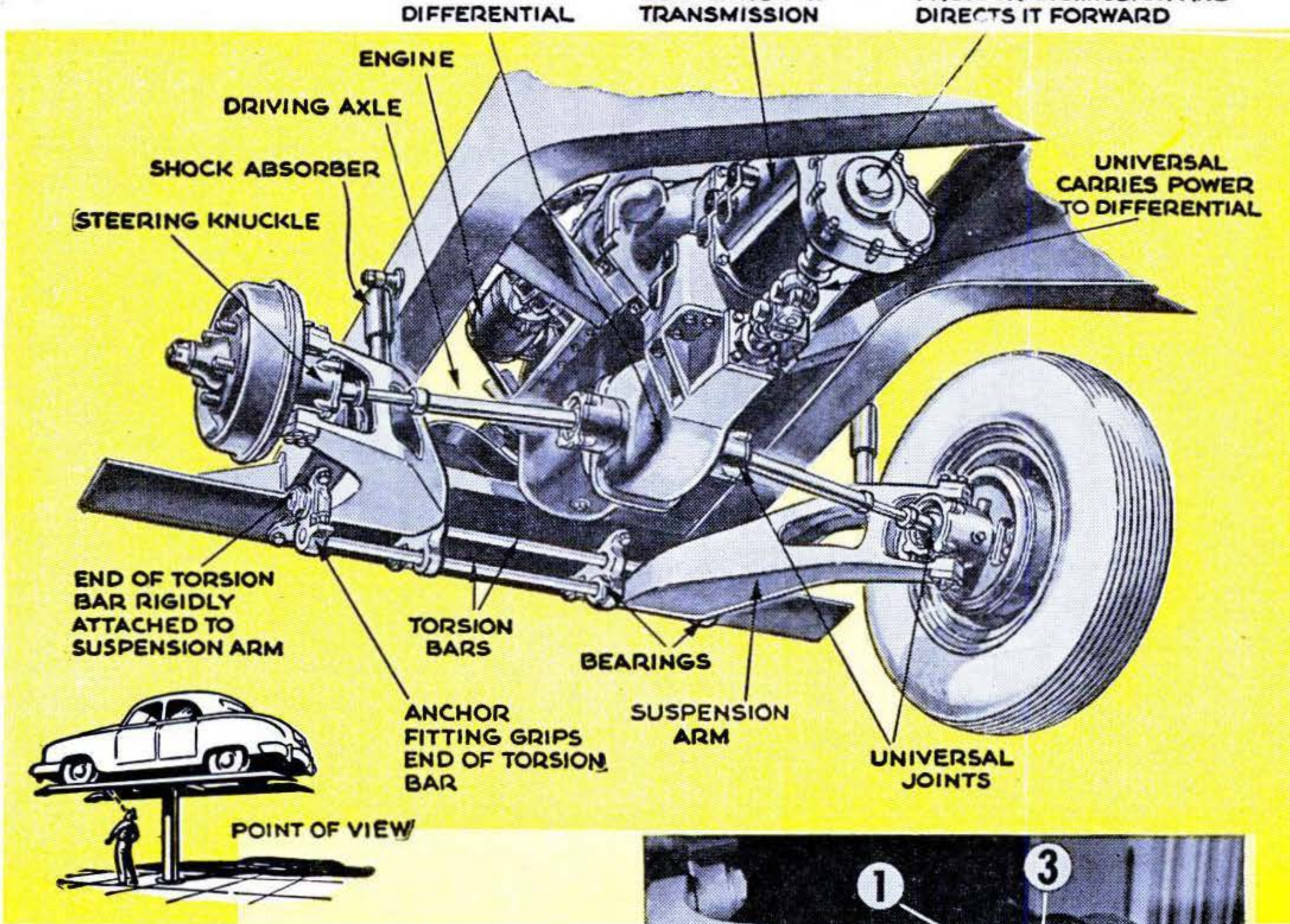
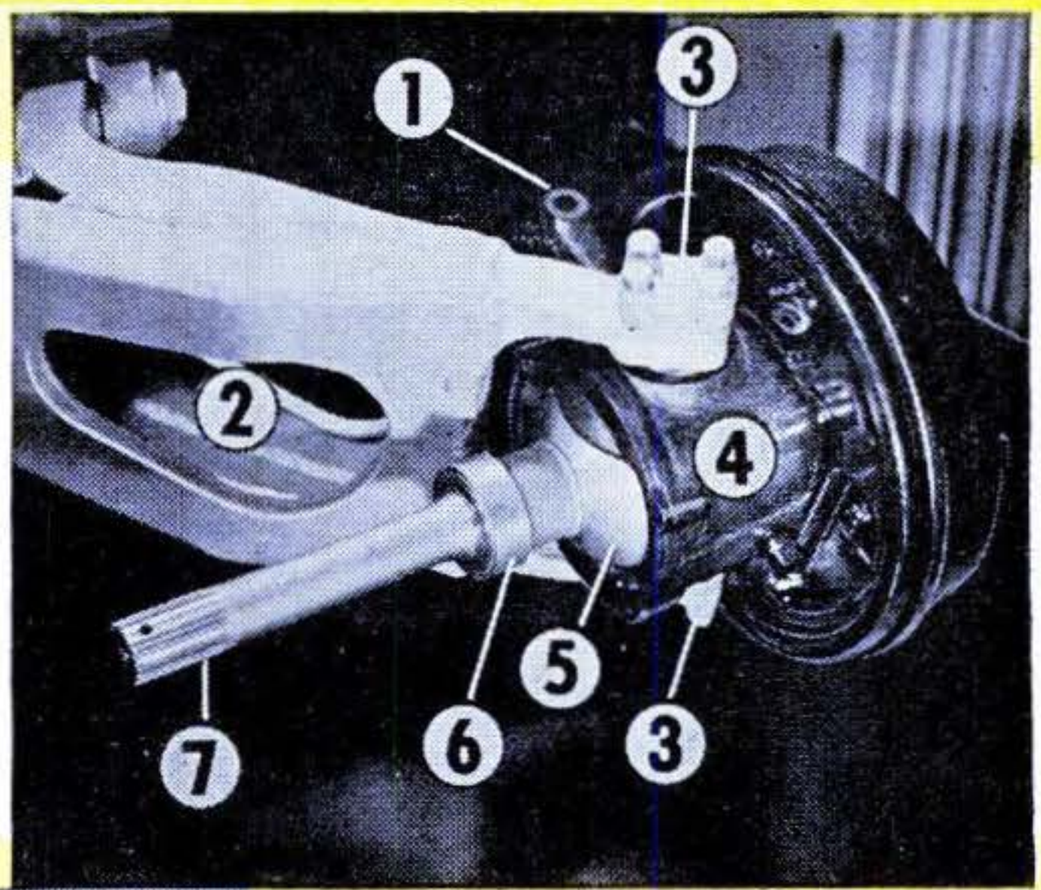
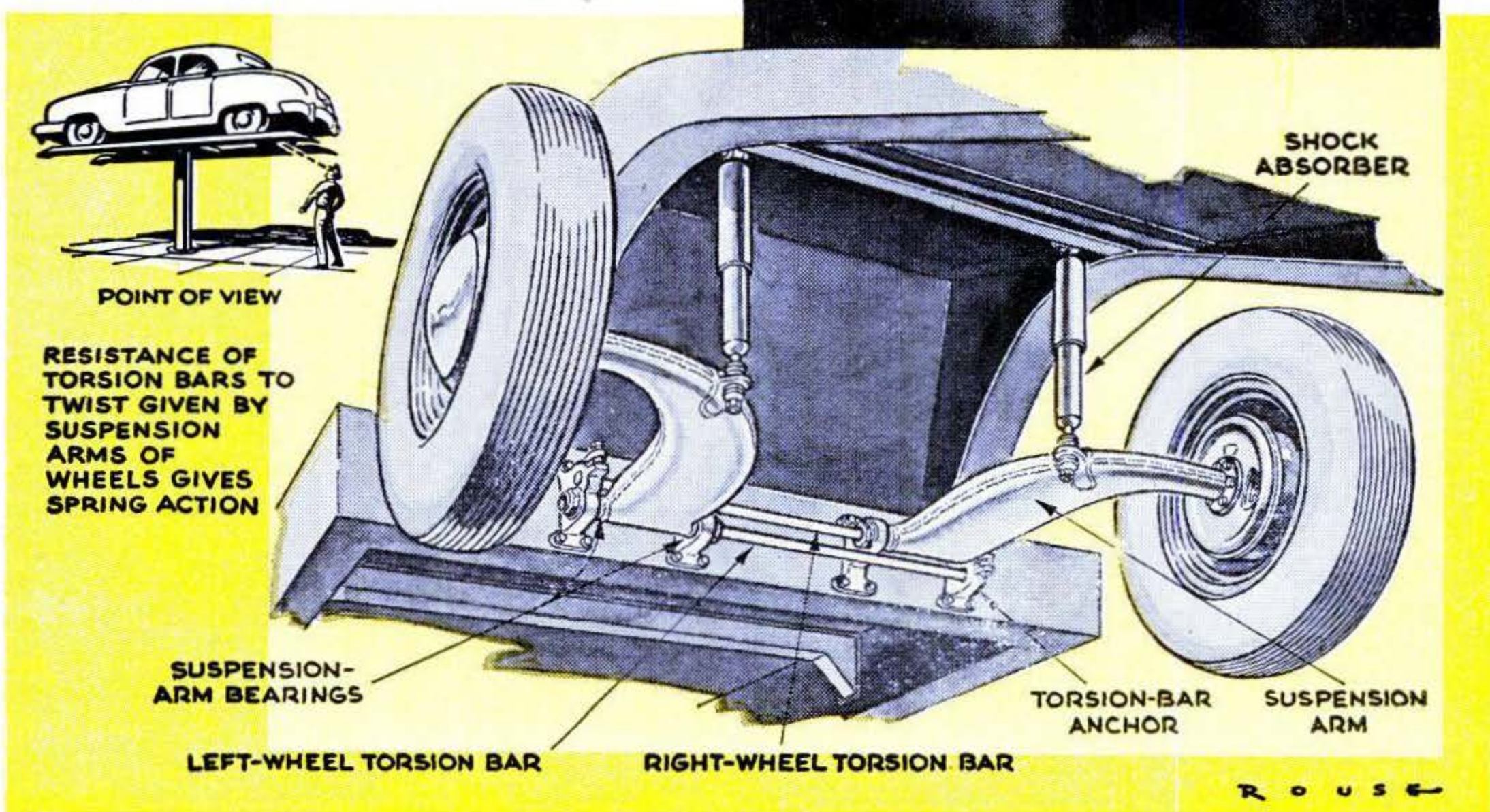




Radical engineering features are high-lighted. **Steering tie rods** (not shown) are conventional.

Driving and steering mechanism of left-front **wheel:** (1) **steering** knuckle arm, (2) hole in **suspension** arm for steering tie rod, (3) king-**pin bearings,** (4) steering knuckle body, (5) **spherical** housing of universal joint, (6) bear-**ing of drive shaft,** and (7) the splined shaft.

Close-up view of rear-wheel assembly shows tor-sion-rod springs. Gas tank fits in over arms.



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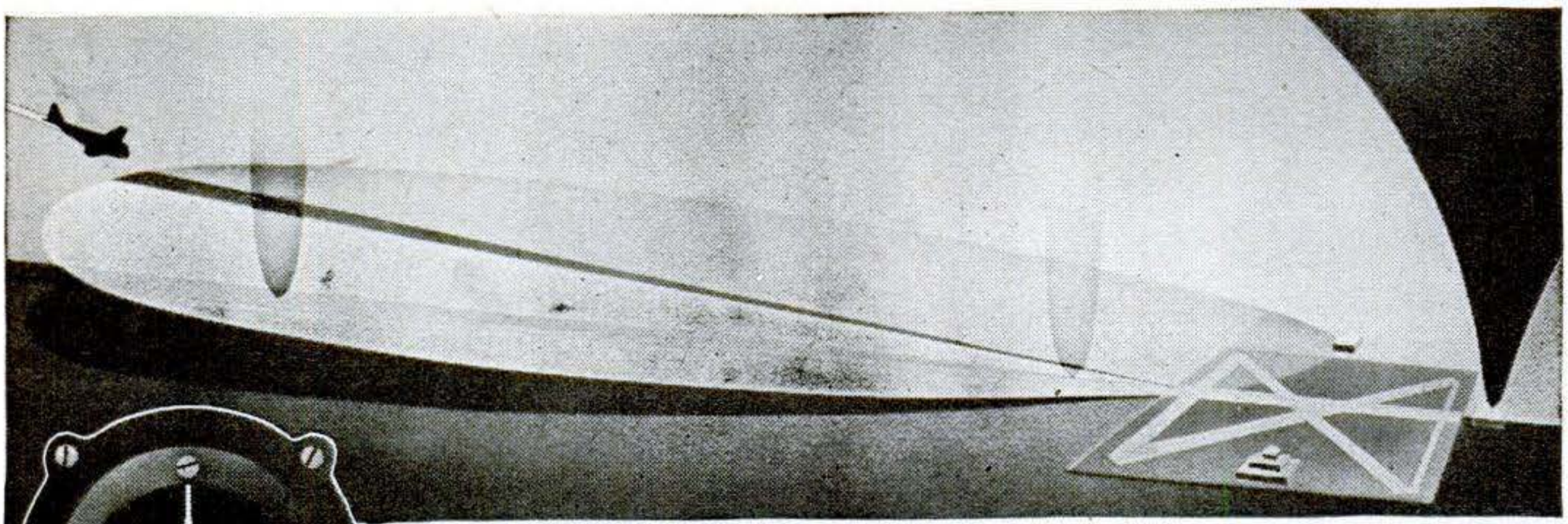

In the radio instrument-landing system, a receiver in the airplane converts high-frequency signals into indications, by crossed pointers on a dial, of the plane's lateral and vertical position. Here, it is lined up with the runway (vertical pointer) but not gliding on the proper path.

By DEVON FRANCIS

IN THE next few months—probably by summer—the reservations counters of the nation's airlines will discard that pat remark made to the customers when the weather closes down: "Due to conditions beyond our control, it has been necessary to cancel your flight."

The air carriers, with the blessing of the Government, are getting ready to fly in anything except weather when a man cannot see his hand in front of his face, or, as the pilots themselves put it, when even the birds are walking.

"Instrument approach" equipment, designed to guide an airliner down to within 100 feet of an airport runway under conditions of smothering fog or heavy snow, is being installed at several score of key airports.

Ultimately, the airlines may carry "instrument landings" a step farther and put their big planes on the ground automatically. Developed by the Army Air Forces, true automatic landings are merely a projection of instrument landings.

Ultimately, too, an entirely new system of navigation and instrument approach, based on radar and television, may be put into operation. The Radio Corporation of America, which makes this proposal, says it will not be ready for actual demonstration for another two years or so.

For the present, the airlines have available a tested instrument-landing system based on ordinary radio. Fundamentally, it consists of four elements: a means of getting a plane lined up with the runway; a means of establishing a track or "glide path" from the sky down to the runway; a way of telling a pilot how far he is from the field; and finally some strong, glareless lights to outline the runway. A pilot needs those

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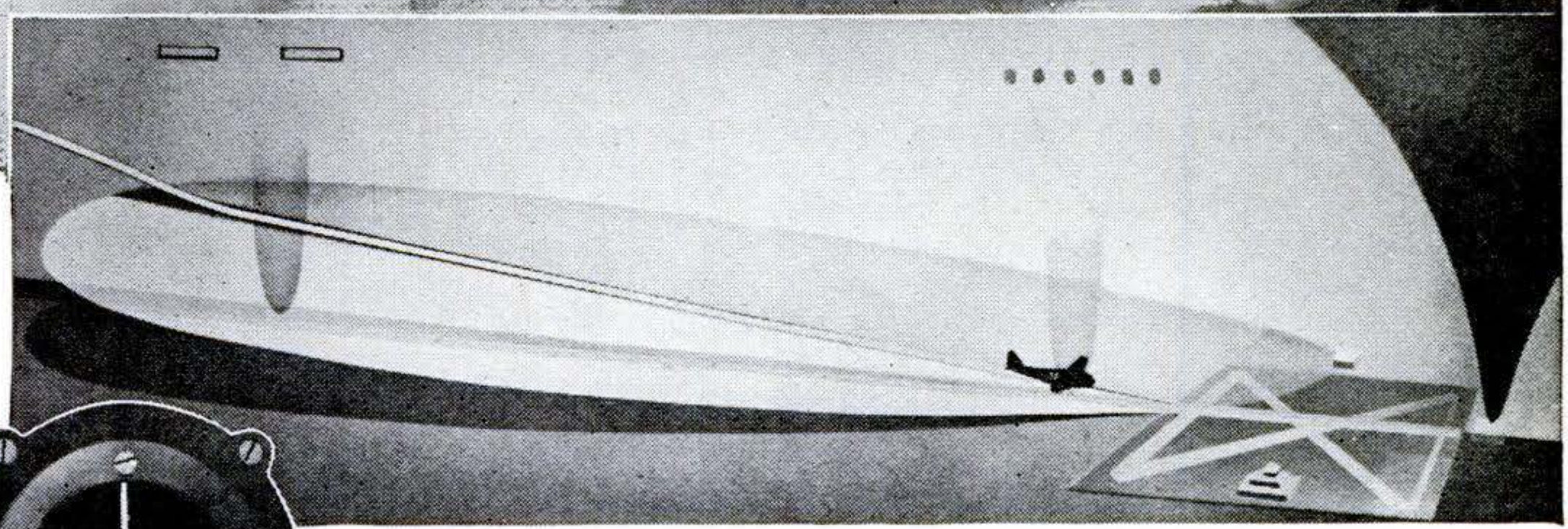
in the soup

AUTOMATIC LANDINGS NOW, "TELERAN" SOON, ASSURE ALL-WEATHER SERVICE ON THE AIRLINES



When the pointers are exactly crossed, the pilot has only to wait for the runway lights to appear. Shadowy vertical shapes on the drawing indicate marker beacons. They shoot radio signals straight up and tell the pilot, by blinking lights on his instrument panel, how near the downwind end of the runway is.

high-intensity lights for that last 100 feet.

The system depends on a phenomenon as old as radio, the fact that ultra-high frequency (short) radio signals can be squirted directively from a transmitter. They not only can be focused in a given direction but can be strengthened by reflectors as well, just as the radiation from the bulb of an automobile headlight can be built up by a mirror behind it.

The directed wave, under good conditions, can be sent out in a pattern so well defined that a pilot can tell within two or three feet whether his plane is lined up with the exact center of an airport runway. Directed waves can be shot into space to establish a path from sky to ground that has almost the stability of a railroad right of way. The drawings on these pages show how the system works.

It was first proposed by the National Bureau of Standards. Physicist Harry Diamond and Engineer Donald M. Stuart, with others, did the preliminary work. International Telephone & Telegraph Corp. engineers put the finishing touches on the system just before U. S. entered the war, and United Air Lines pioneered in trying out the equipment experimentally.

Growing out of this is the Army's system for automatic landings. Instead of making the pointers on the dial evoke reactions from the pilot, the radio signals are fed directly into the automatic pilot. Actually, the Army system is semi-automatic. It is designed to bring a plane down to a point just off the runway. But a plane can land itself, if needs be. Several score of wholly automatic landings have been made.

There are other instrument-landing systems. The Army during the war employed a GCA (ground-control approach) system, originated by Gilfillan Brothers, Inc., of Los Angeles. Radar operators on the ground

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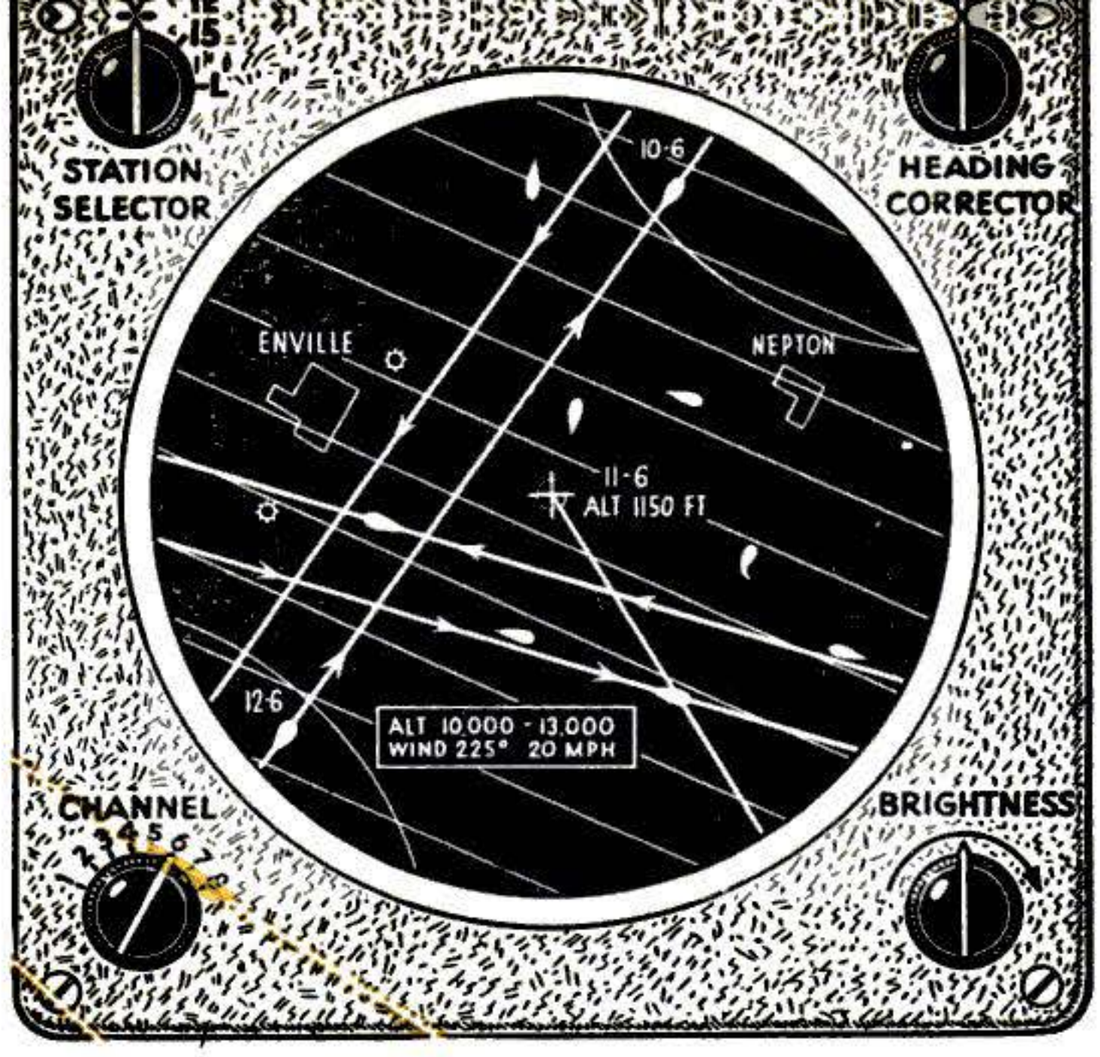
AIRPLANE CARRIES RADAR RESPONDER AND TELEVISION RECEIVER



plotted the positions of aircraft in the air on their 'scopes and "talked" pilots into their landings.

The proposed radar-television system appears, on its face, to have the greatest potentialities. Called Teleran (TELEvision-Radar Air Navigation), it is based on the purely human propensity of a pilot to imagine his plane as a dot moving across a map.

In the Teleran system, RCA engineers use a Plan Position Indicator type of radar (see PSM, Sept. '45, p. 65; Oct. '45, p. 84) to search the sky for aircraft, both en route between terminal airports and in the vicinity of airports. Television cameras are focused on the oscilloscopes of several radar sets doing different kinds of jobs. The information picked up by the cameras is televised to the planes.

A transparent map is superimposed on the PPI image at the television transmitter. A pilot, glancing at the face of his television receiver on the instrument panel, sees himself as a radar "pip" or spot of light moving across the map. Compass indications are written on the map, of course, so that he has a reference with relation to his magnetic heading.

Through a "sector scan" radar he gets what amounts to a three-dimensional view of the airport, his position with relation to it, a glide path to follow, and a line-up with the runway.

A question naturally arises: how can a pilot recognize his own plane among all the blobs of light on his television receiver? A peculiarity of radar takes care of that.

All radar images are created by scanning. Radar beams can be compared with those of a rotating beacon in a lighthouse. As the beams strike a plane, activating a "responder," a line of light—actually a wave of signals sweeping by—appears on the television receiver. It glows. The line of light passes through the blob of light representing a pilot's own plane. When the beam of signals has passed by, the line begins to fade—"decay." Before the decay is complete the line is renewed by another sweep of the beams. These sweeps occur every four to six seconds.

As the airplane starts its landing glide, electrical circuits compare its altitude and distance from the airport with an "ideal" glide path. This ideal path is created by deflecting an electron beam within an oscilloscope. The beam creates a dot of light on the PPI image and the dot, routed through a cylindrical lens, is transformed into a straight line to guide the plane to a point just above the runway. Teleran engineers propose to bring an airplane to within 50 feet of the runway. There, the pilot will go through his normal, visual landing maneuver with the aid of high-intensity lights outlining the runway.

Teleran will do far more. Connected to the barometric altimeter, it automatically will keep the television reading on the proper altitude. That simplifies things for a pilot. He isn't interested in planes at other altitudes. It will permit the sending of up-to-the-minute weather maps to planes aloft. It can cut to a trickle the already vast volume of conversation on airline radio frequencies necessary to take-off, navigation, and landings.

If a control tower wants to communicate with a pilot, it need only write a message and put it in front of the television camera. If two planes get too close together, a tower operator can put a pointer on one of the spots of light on the map and motion to the pilot to slow down or move over.

The system is in the engineering stage. Its fundamentals already have been researched and demonstrated. It was outlined as early as 1941, two years after television images experimentally had been transmitted for the first time to an airplane in flight. Work on the system is divided between the RCA Laboratories Division at Princeton, N. J., and the RCA-Victor Division at Camden.

Take-offs under zero-zero conditions are, of course, no problem. All a pilot has to do is set his gyrocompass for directional guidance, open his throttles, and pull back on the control wheel when the air-speed indicator says it is time to fly. After that it is a matter of conventional instrument flying.

But instrument landings are about here. They will permit at least 20 landings an hour on a single runway in bad weather. Installations for them are planned for 125 of the nation's airports.

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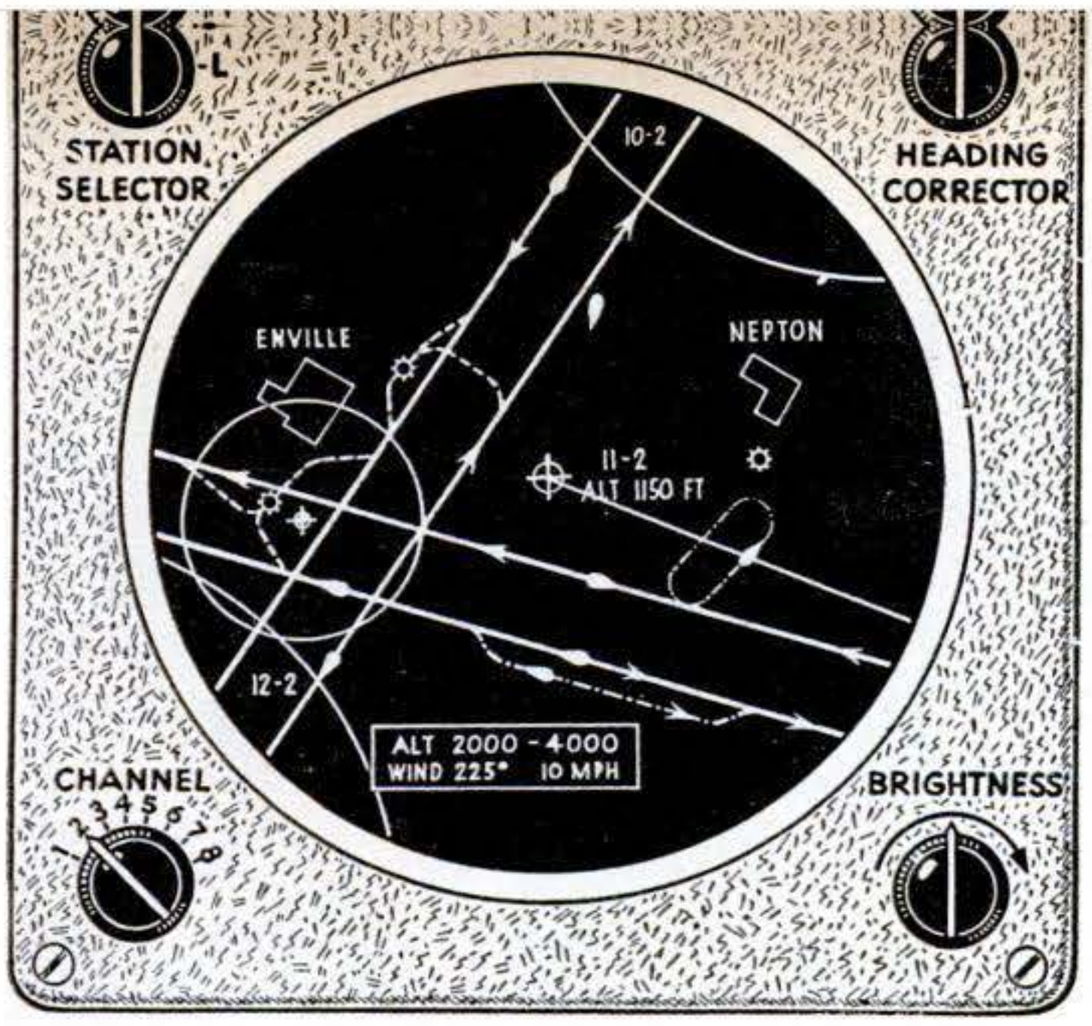
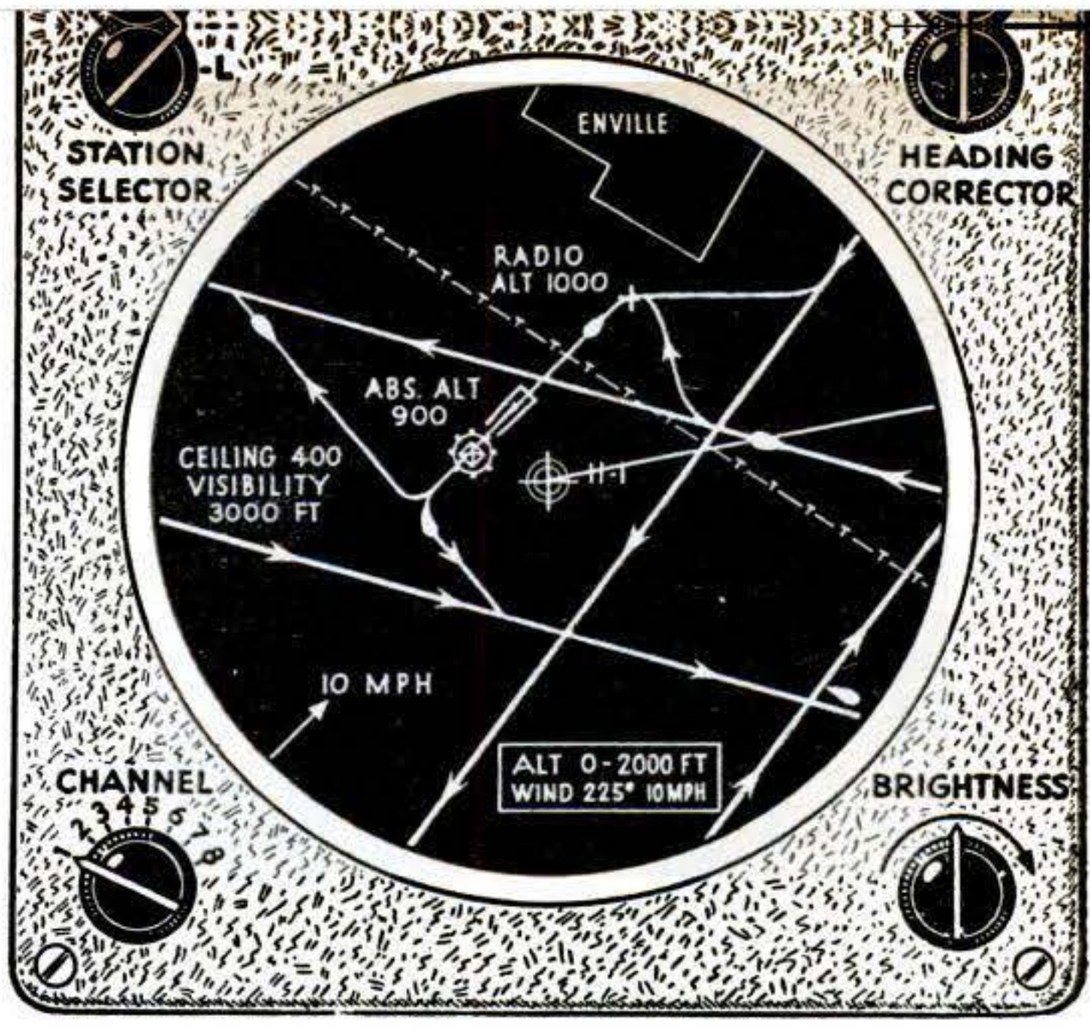


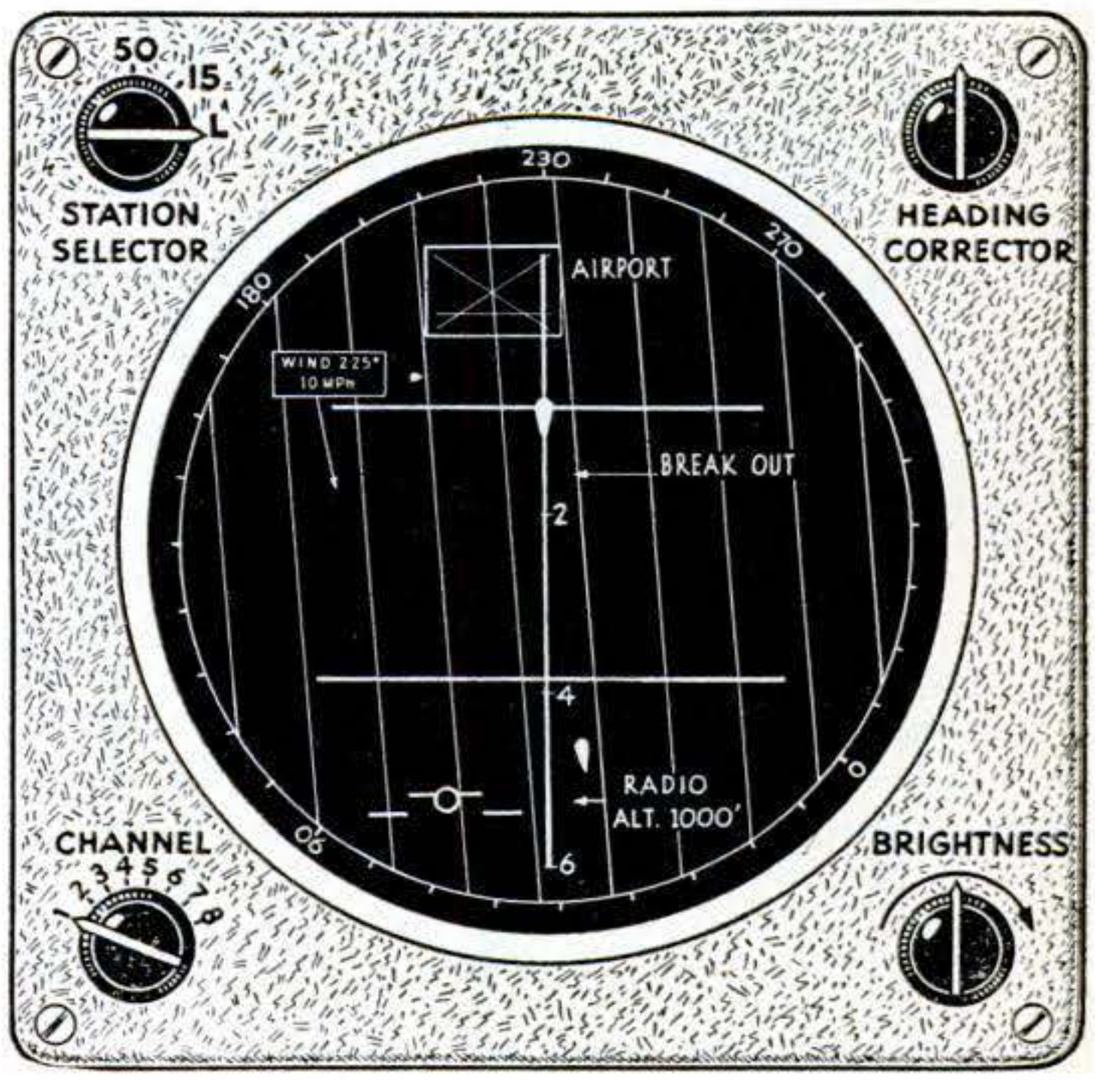


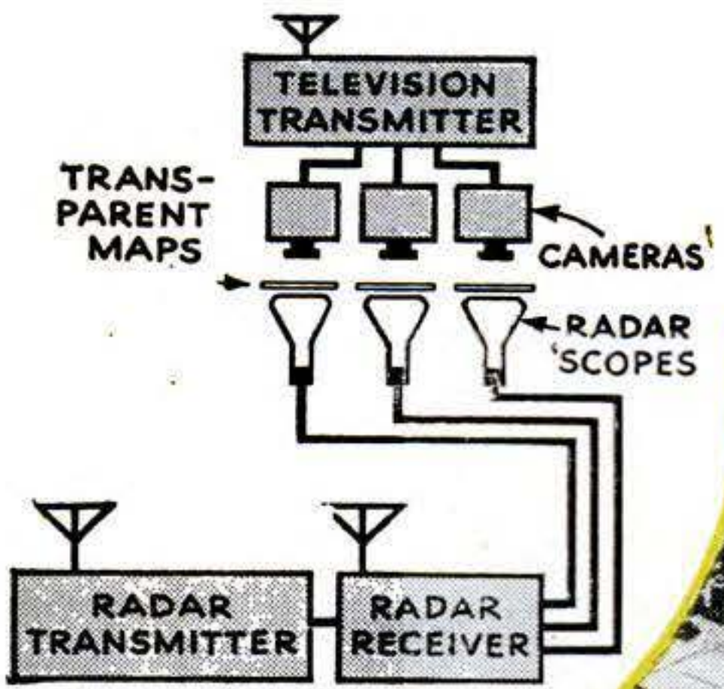
1. Receiver for Teleran, proposed radar-television system for all-weather flying, has four controls. Planes appear on the 'scope as pear-shaped blobs.

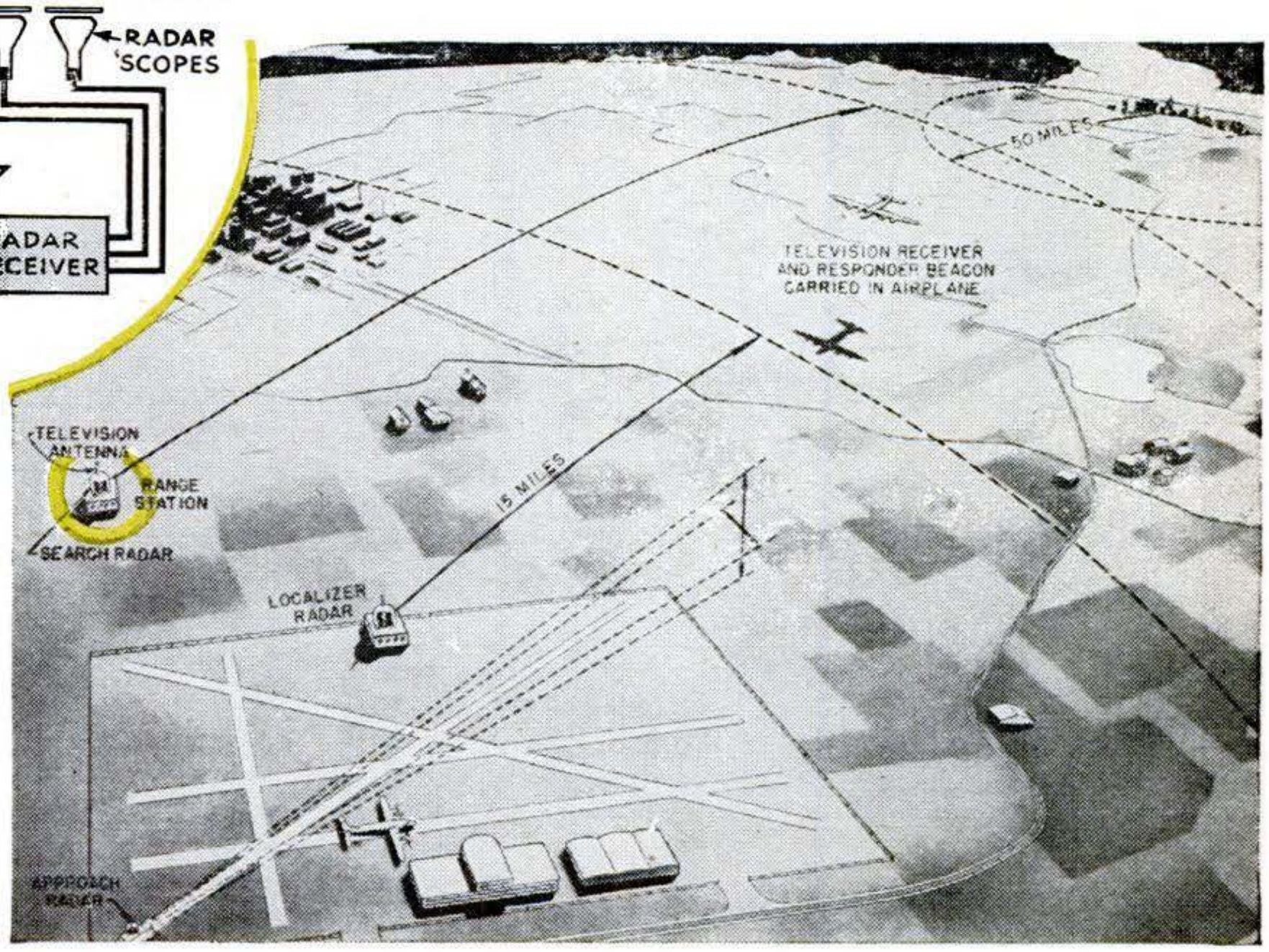
2. Station selector, tuned to radar with 50-mile radius when the airplane is en route, is turned to 15-mile-radius radar as plane nears airport.

3. Channel selector enables pilot to "see" all airplanes including his own (speared by thin line of light), within his altitude and radius range.

4. With station and channel selectors tuned for landing, pilot's plane must be centered on the crossbar of light, indicating ideal glide path.







Receiver-responder in plane reflects radar signals to a ground 'scope covering plane's area. Television transmitter picks up what appears on that particular 'scope. "Altitude separation" on the cockpit 'scope results.

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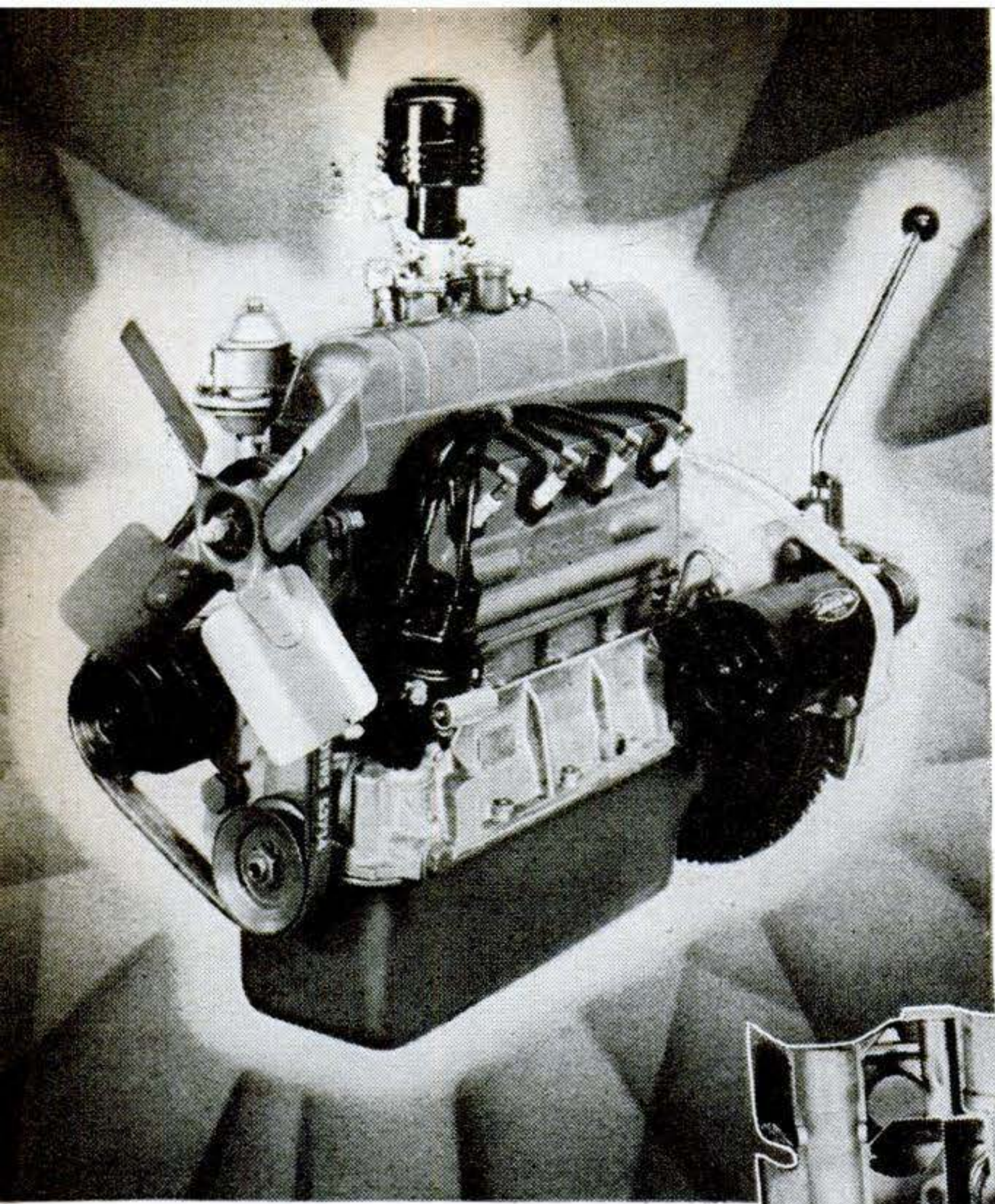
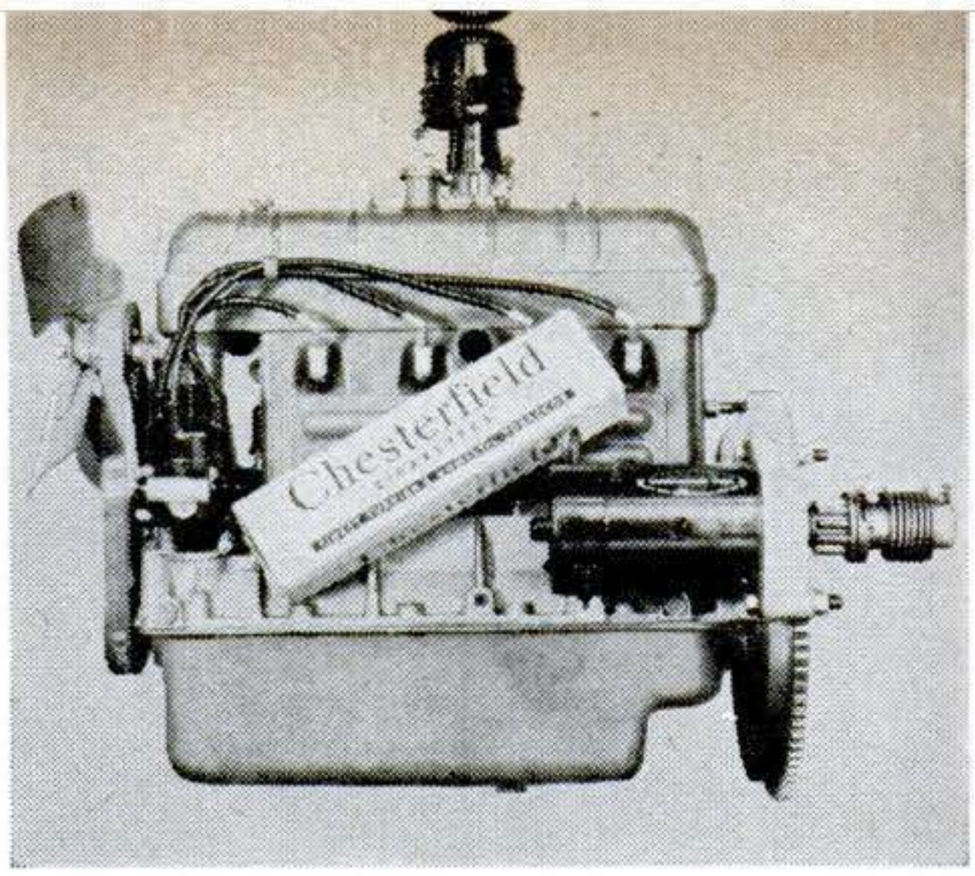
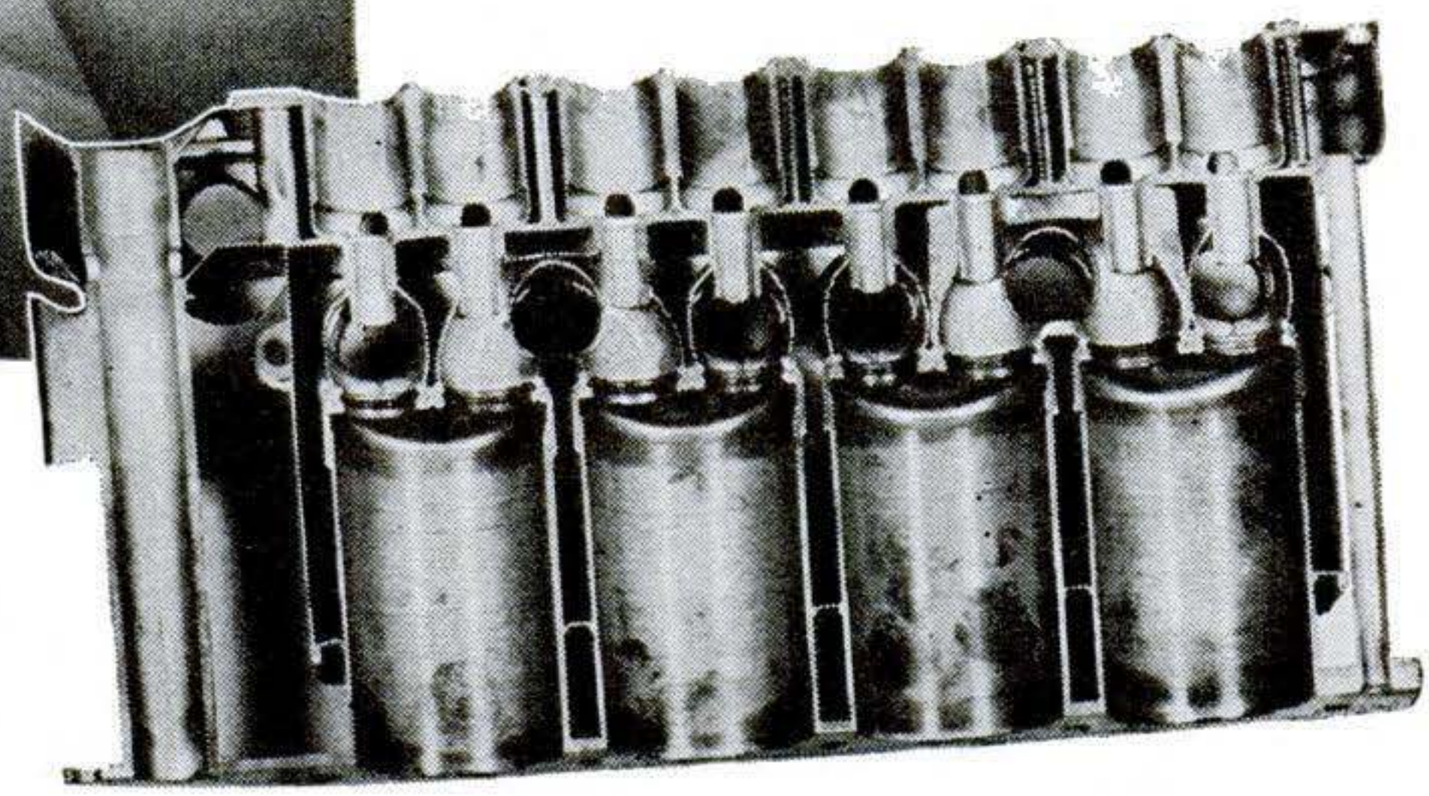


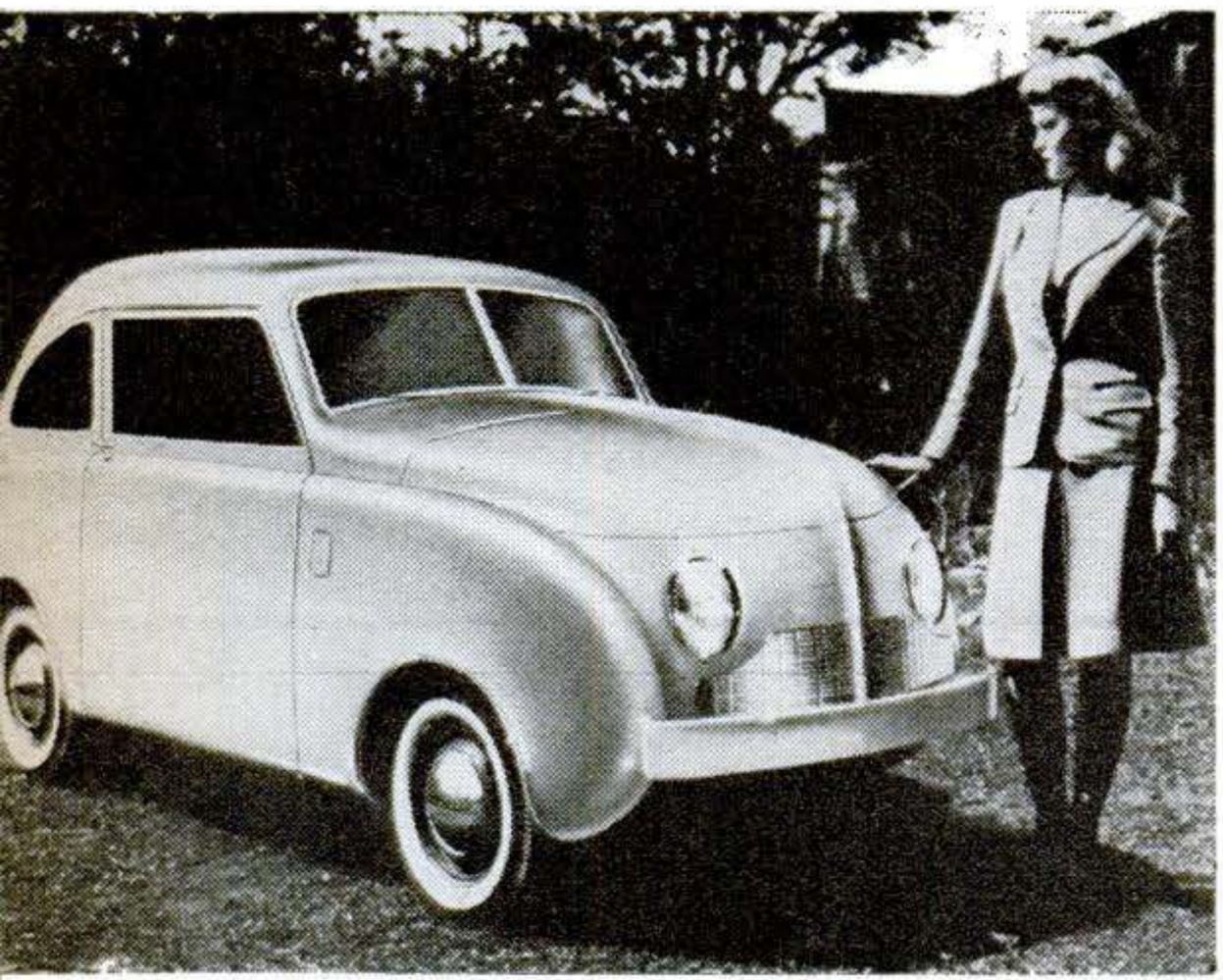


Lay a carton of cigarettes alongside the engine, and you'll get a good idea of the size. Compression rating is 7.5 to 1, and 80-octane gas does not produce a knock at any speed. Engine has 2½-inch bore, 2¼ stroke.



The Crosley-Taylor engine with the accessories shown weighs only 138 pounds. It will drive a 1,000-pound car at 60 m.p.h. Parts are stamped from sheet metal, then crimped to other parts, and brazed. Cylinders are of alloy steel.

59-Pound Motor Drives Car 60 m.p.h.



The body of the pygmy car is made of aluminum. The wheelbase is 80 inches. Its over-all height is 57 inches, and it has accommodations for four persons.

A STAMPED-OUT automobile engine developing 26 hp. and weighing only 59 pounds stripped has been shown in Cincinnati by Crosley Motors, Inc. This low-cost midget can drive the 1946 Crosley car at a top speed of a mile a minute, while at 35 m.p.h. it will do 50 miles on a gallon of gas.

The engine is built on a radically new principle. Thin sheet-metal stampings are used instead of heavy forgings and castings. Cylinder walls are only one sixteenth inch thick, and are crimped to other parts of the engine. Pure copper is then melted into the joints, after which the spot-welded engine spends an hour in a hydrogen furnace for brazing.

A hard coat of plastic inside the water jacket is applied during the baking process. This prevents rust and guards against damage by freezing. The motor operates at 5,000 r.p.m. Wartime uses included the starting of B-29 engines and supplying electric power for gun turrets.

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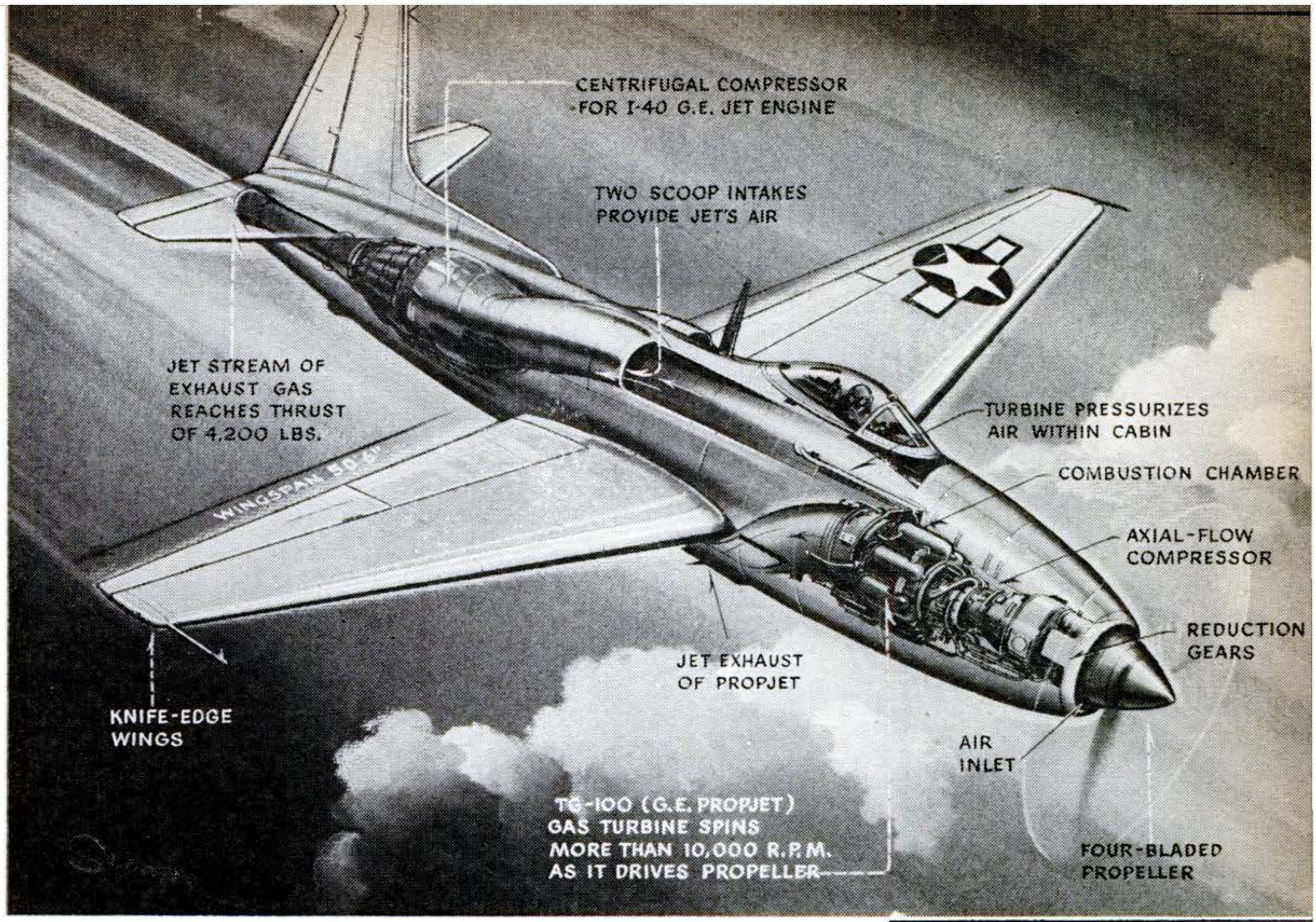
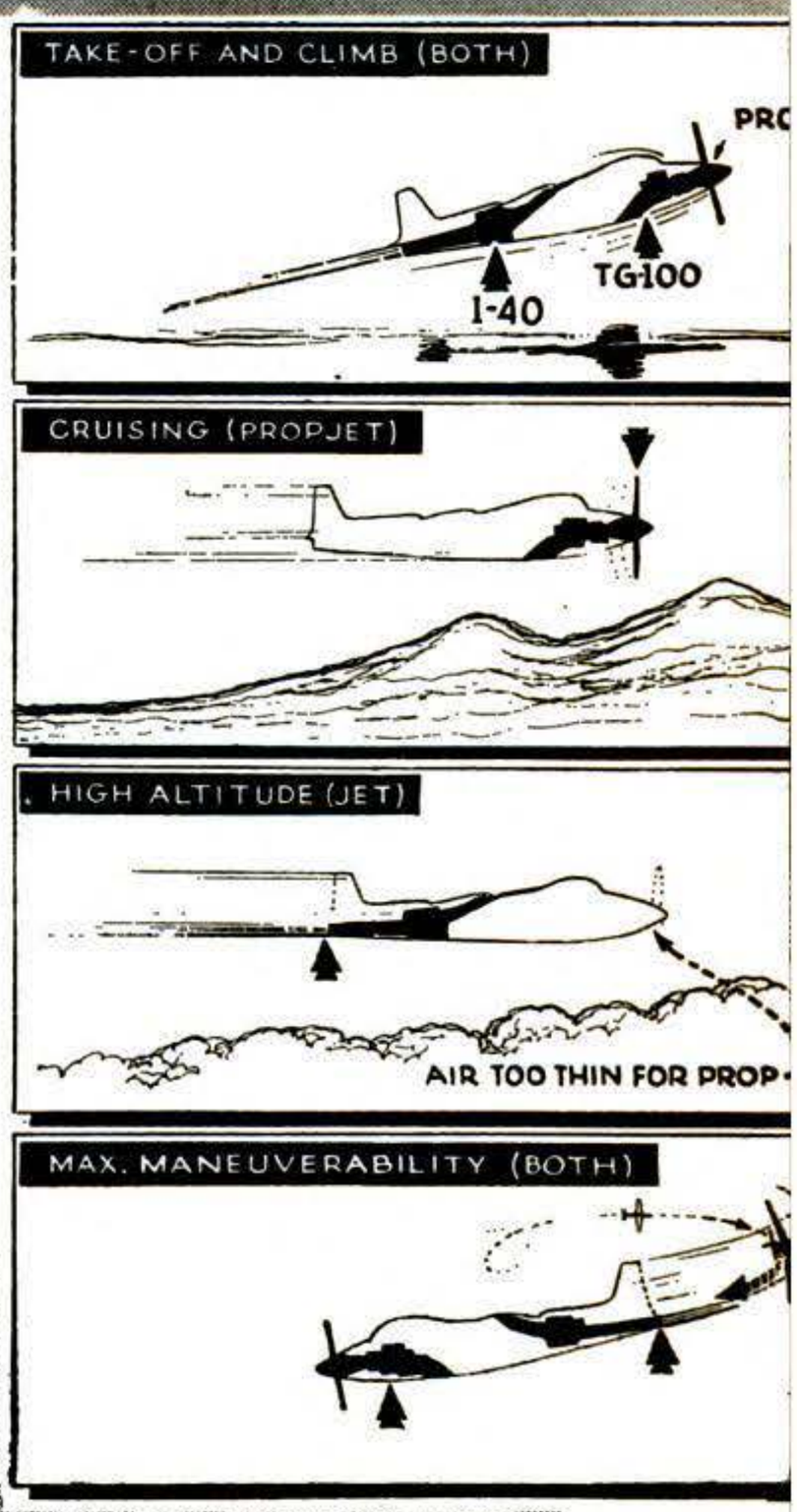
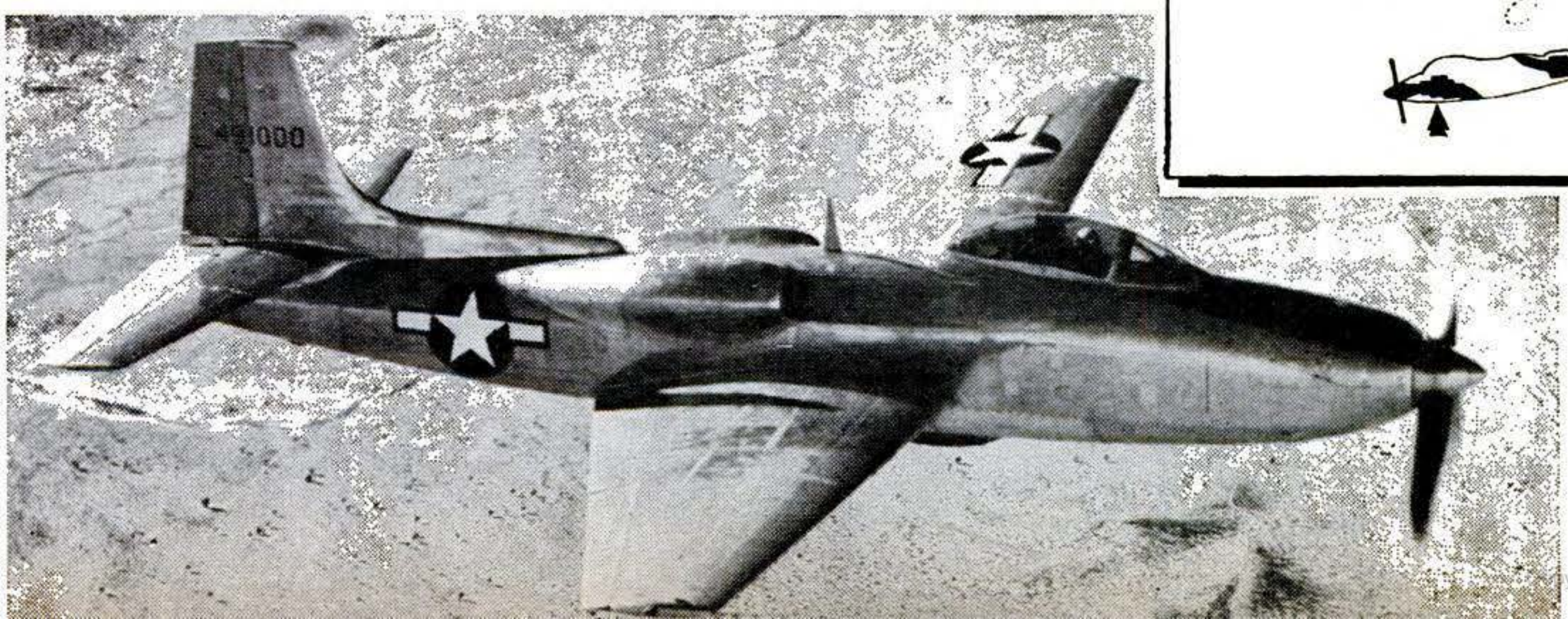


Jet Plus "Propjet" Hurl the XP-81, New Fighter, Through the Sky

AS THE ultimate combination of jet and propeller drive for combat airplanes, the Army Air Forces are now testing a fighter equipped with two gas turbines—one to produce thrust by jet reaction and the other to provide rotation for a propeller on the nose. The two engines, fitted to the Consolidated Vultee XP-81, can produce almost as much power as the four 2,200-hp. engines of a Superfortress.

The XP-81 ("X" for experimental and "P" for fighter) is the first plane ever to fly with power generated by a gas turbine specifically designed to drive a propeller. (The propeller of the jet-and-propeller driven Ryan Fireball is spun by a conventional reciprocating engine.) The "Propjet" unit, as it is called, also pressurizes the cabin for high altitudes. The Propjet and the I-40 turbine, for straight jet propulsion, were both developed by General Electric.





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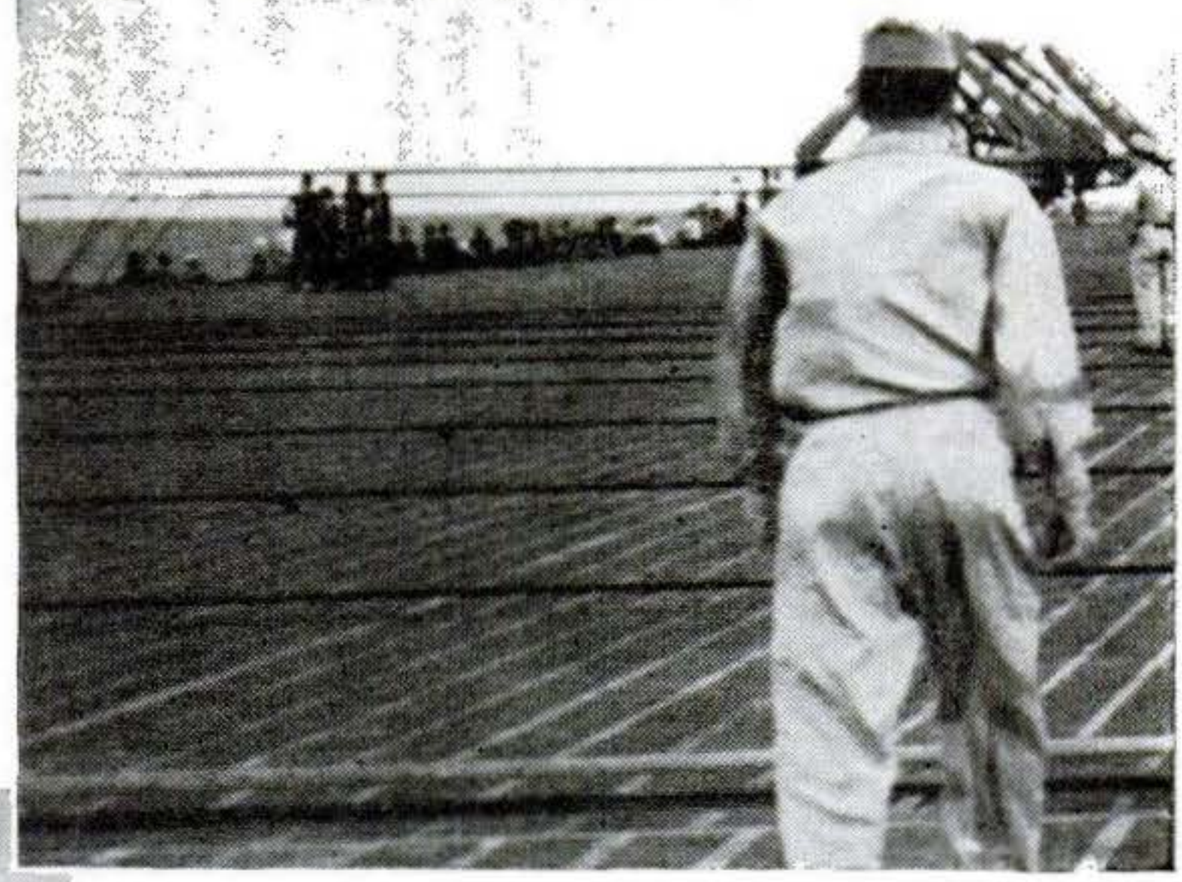
World's BIGGEST

Here, in breath-taking photographs by Popular Science's W. W. Morris, and the Navy, is the *first* picture story of the world's largest warship and most heavily armed carrier, the "Mighty Middy"—CVB-41 in Navy talk. (The CV stands for aircraft carrier and the B means big.) The conflict ended as the Navy was readying the *Midway* for action, so she and her sister ships, the *Franklin D. Roosevelt* and the *Coral Sea,* didn't reach the shooting war.

Fifty thousand pounds of bombs ready for delivery by part of the *Midway's* Curtiss Helldivers. Another plane type aboard the floating airfield is the 400-m.p.h. Vought Corsair. Newer craft are in the offing, and, as they are developed and accepted by the Navy, will be added to the Mighty Middy's arsenal.



The Helldiver below, about to drop a message, has a wing span of 50 feet but still is dwarfed by the wide expanse of the *Midway's* deck. This is a fliers' heaven. Naval airmen shiver at memories of landing their ships aboard the 65-to-75-foot decks of baby flat-tops pitching and tossing in angry seas.

A pilot, directed to bring his fighter in on the *Midway,* quipped dryly, "Which runway?" Two planes *could* easily land abreast on this 986-foot-long and 113-foot-wide flight deck.

Part of Mighty Middy's defensive strength is seen (at right) in the nine new long-barreled, five-inch, 54 caliber rifles on the starboard and the eight 40-mm. Bofors on the bow. Kamikazes would have bounced off her armor plate laid under the flight deck. "Middy" is home for some 3,500 men; it has a soda fountain, gymnasium, library, church, theater, post office, and even an organ that was presented by the garrison at Midway Island.

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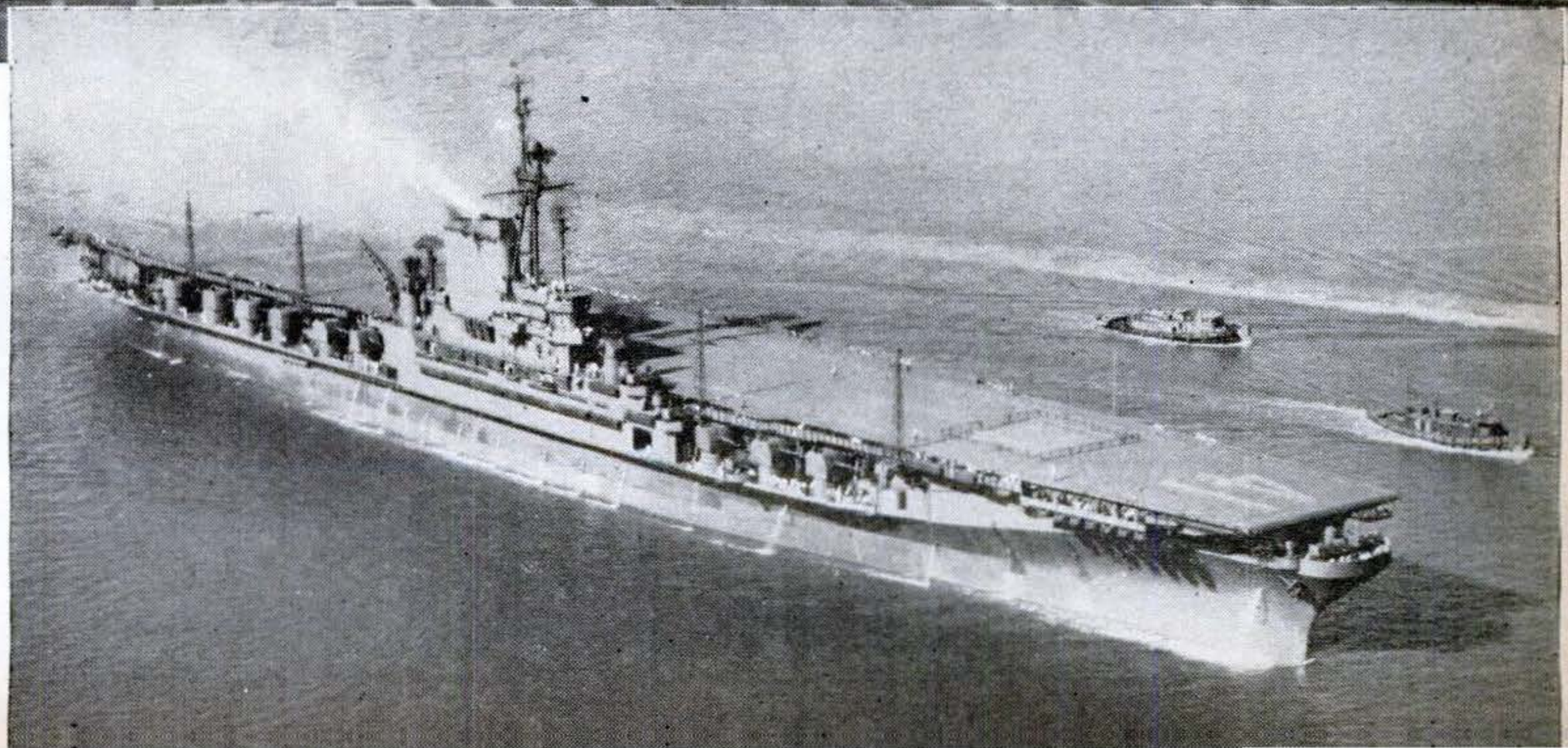
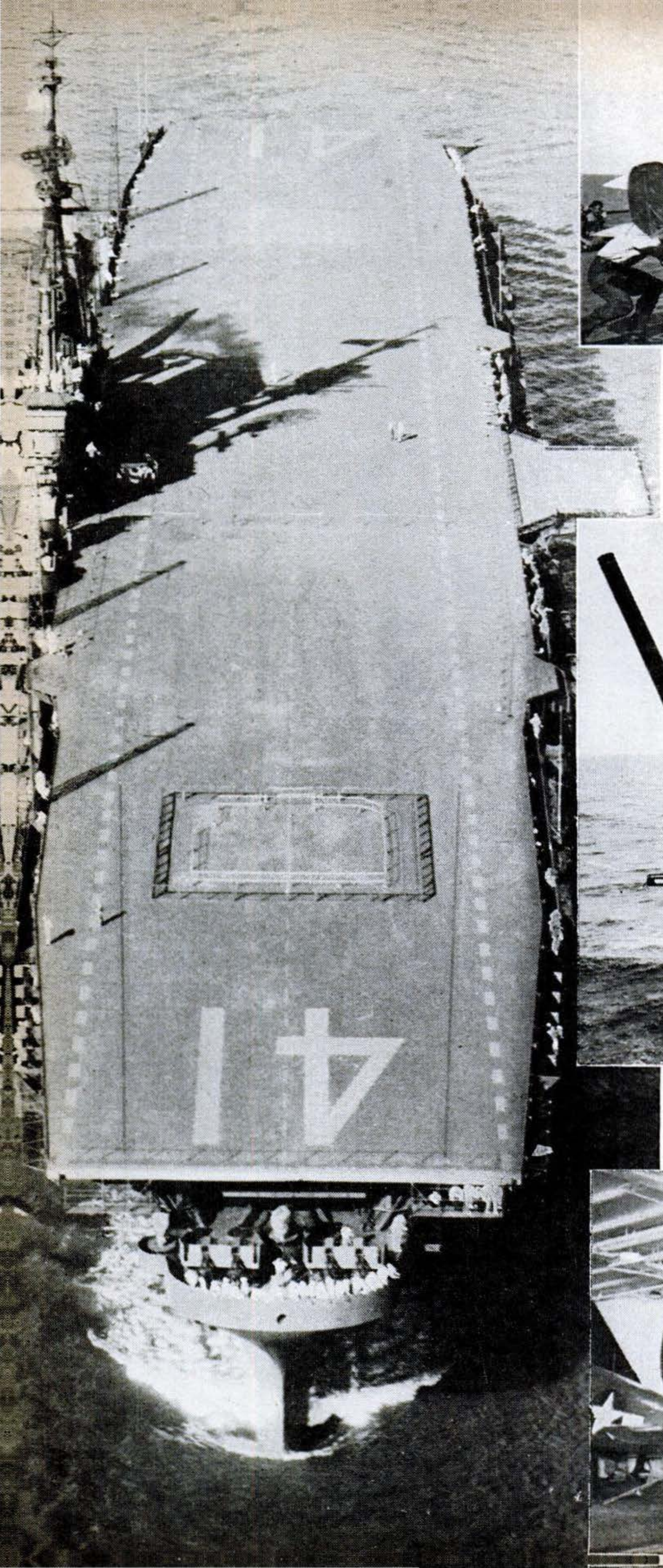
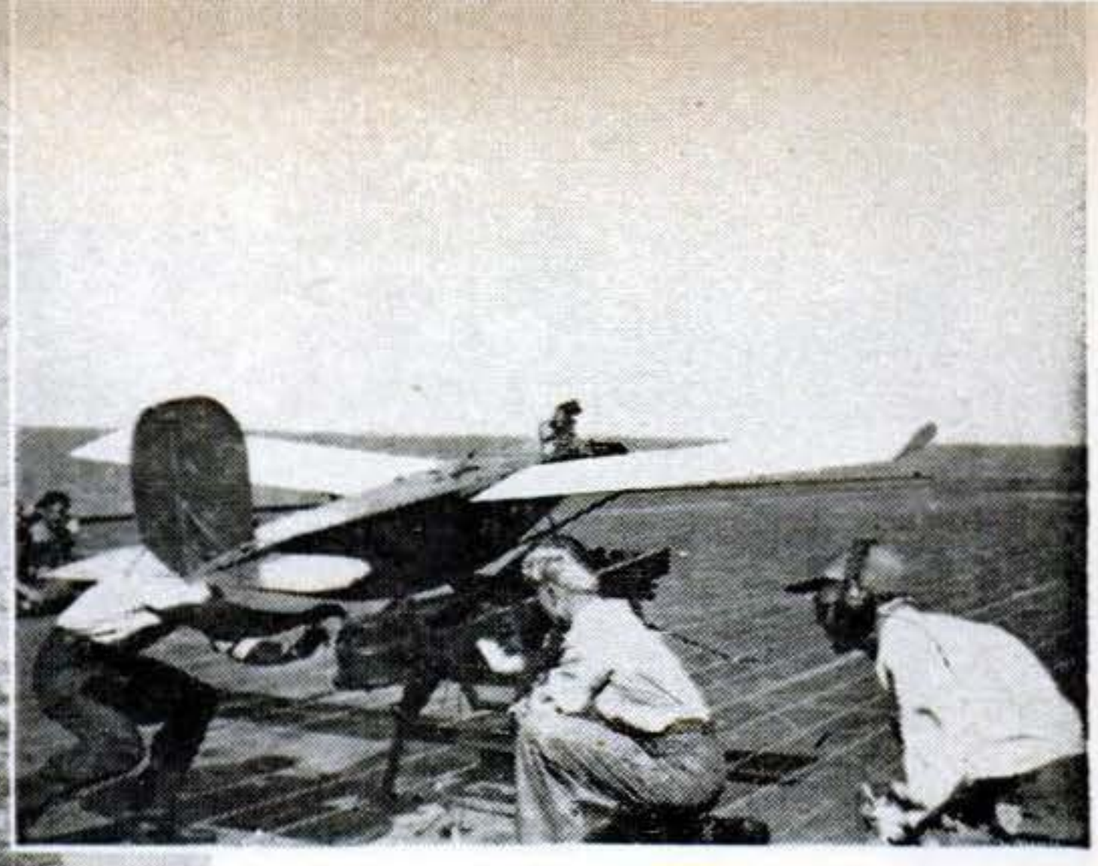
Warship U.S.S. Midway

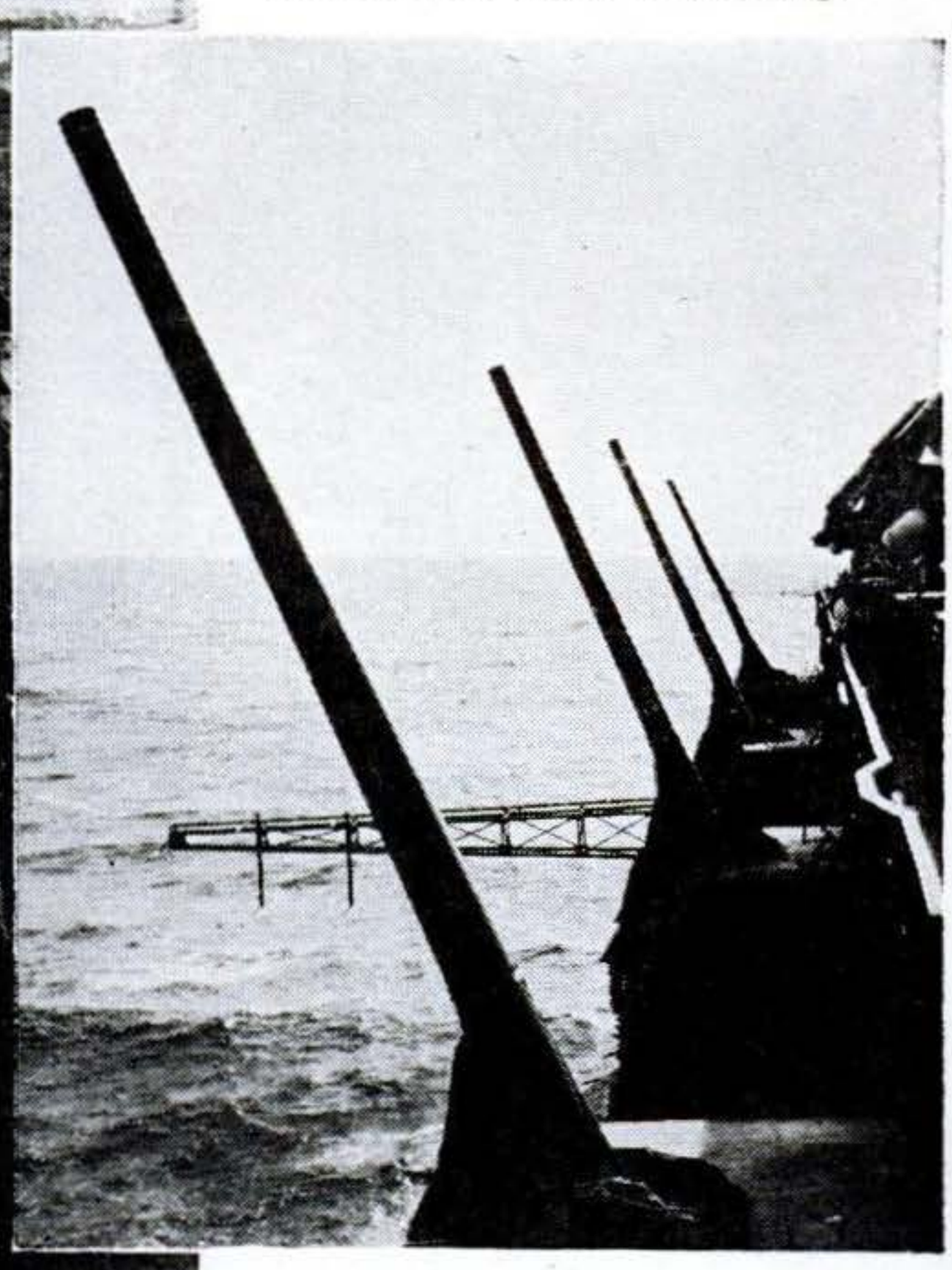




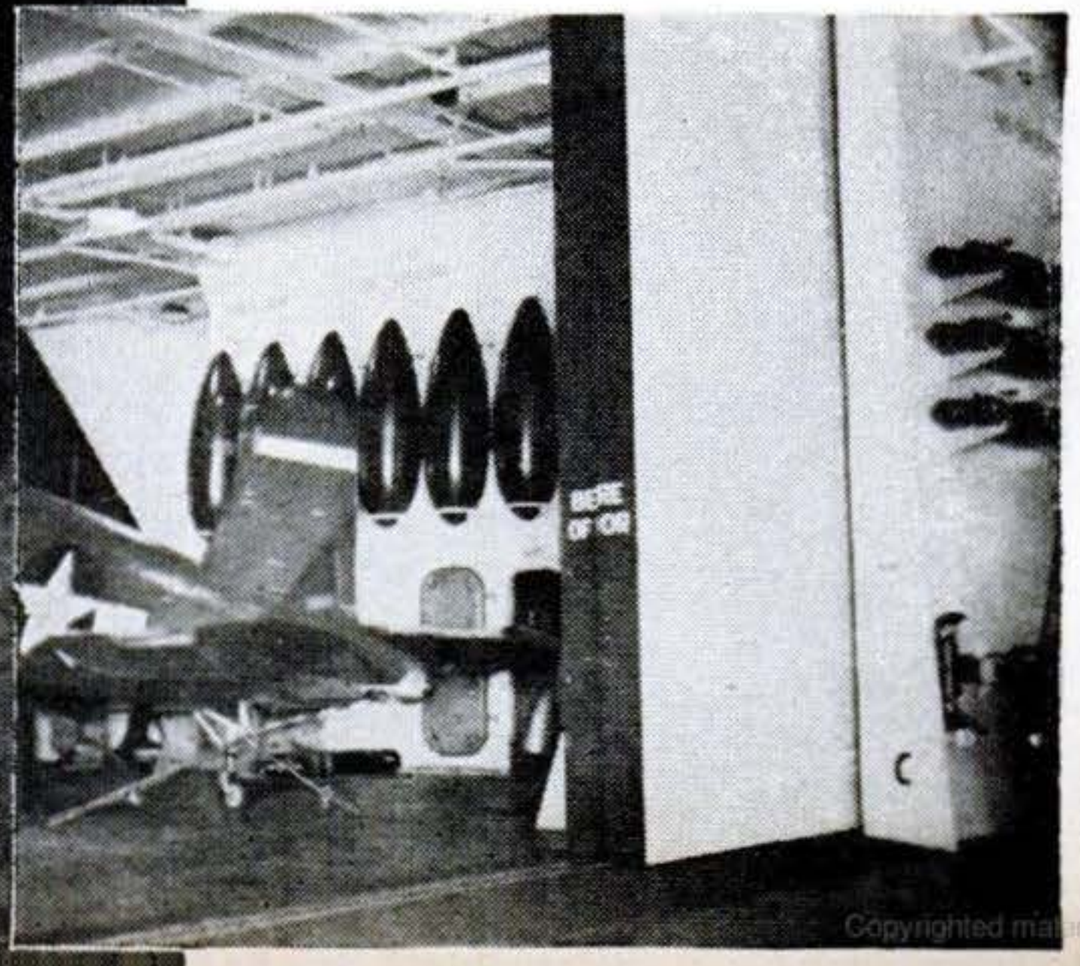


A radio-controlled target plane, on which AA gunners sharpen aim, is launched from the deck.

Four five-inchers point ominously upward (below). Projecting framework is for boat-lowering.



On the hangar deck, four sets of mammoth steel doors, like the one below, can be shut in eight seconds to localize any fire.



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FLIGHT QUARTERS

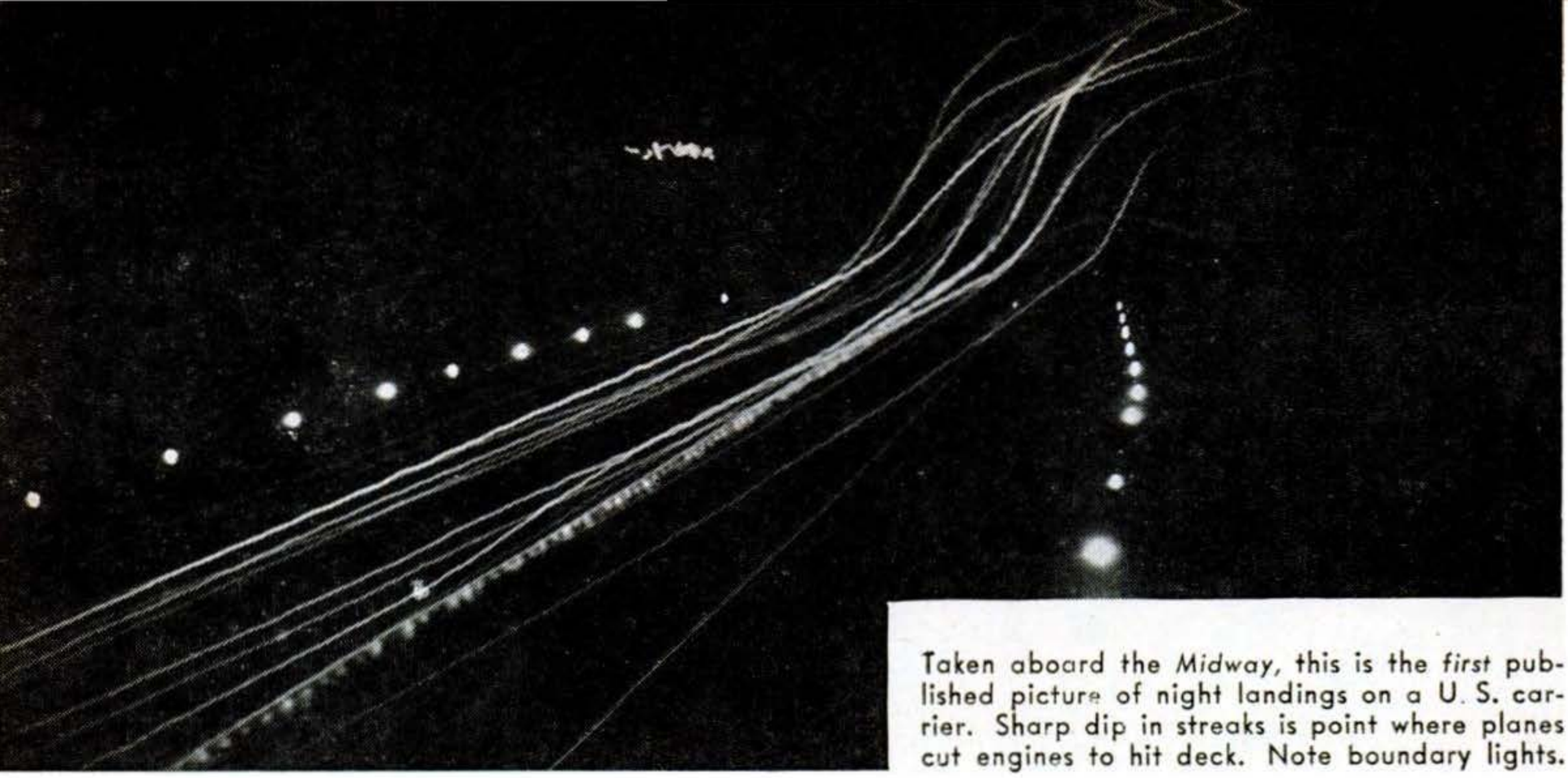
"Signals" waves in a Helldiver, safely home. Left, radar eyes and ears of *Midway*.

Left low wing! After leveling, pilot will get throat-cutting gesture from "Signals" to "drop everything."

He's on, then hooks the third of 11 arresting wires. Fiddle bridge to raise wire is new type.

Who-o-rong! Cable brakes speeding 7½-ton dive bomber to a full stop in 75 feet.

Flight-deck crew moves in on the double so next ship will have a clear runway.

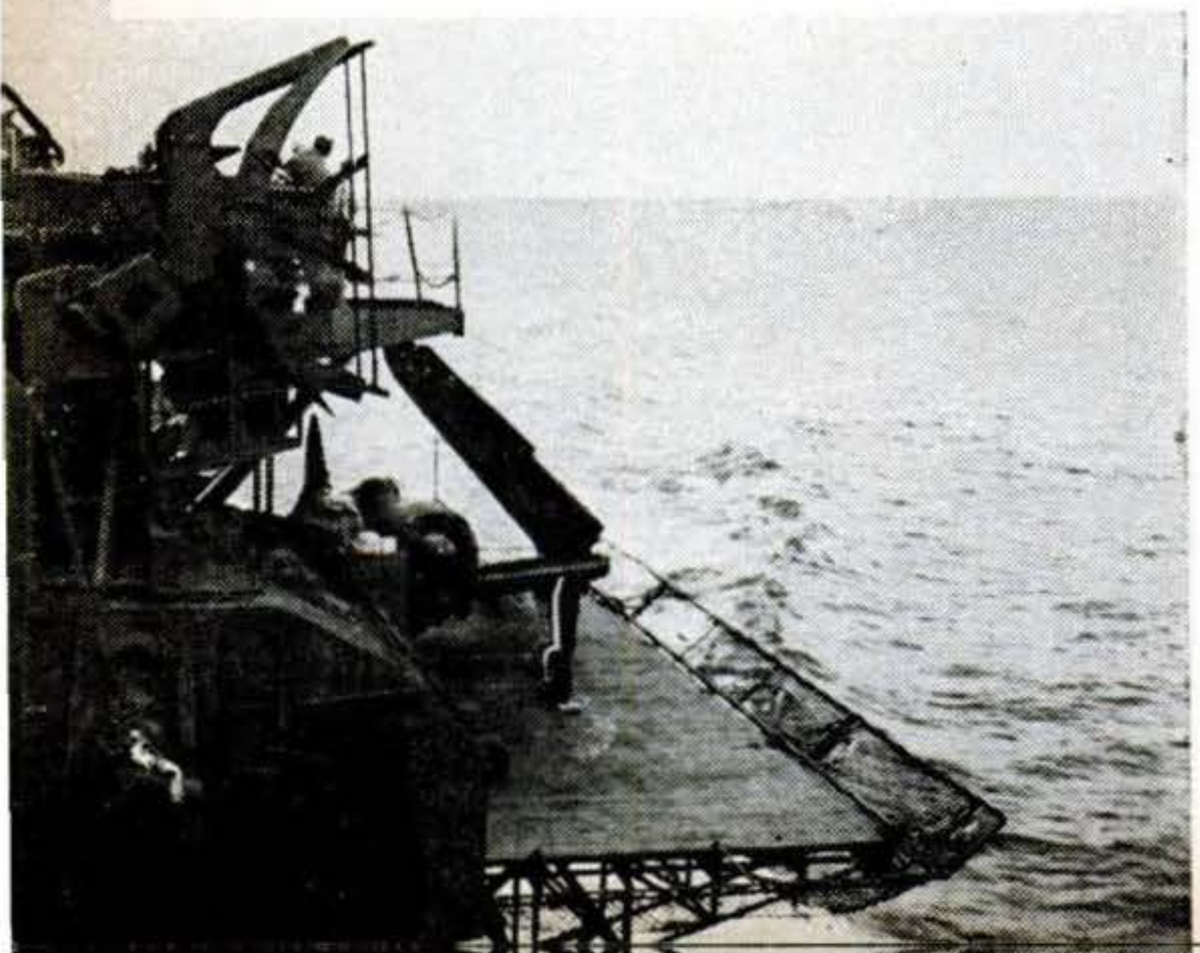


Taken aboard the *Midway*, this is the *first* published picture of night landings on a U. S. carrier. Sharp dip in streaks is point where planes cut engines to hit deck. Note boundary lights.

Crewmen hook a Corsair to the hydraulic catapult that accelerates a plane from zero to 70 m.p.h. within 60 feet. "Kicking off" a warbird eliminates the need of turning into the wind, often away from a fleeing enemy.

Its mission completed, this Helldiver has its wings folded and is quickly spotted on the deck-edge elevator by the Aircraft Control Officer as crewmen wait with chocks that will hold it as it is lowered to the hangar deck.

Going down! And in it is the plane captain, an enlisted man who will turn the ship over to the "ground" crew that will immediately begin the work of repairing and refueling it.



Into "the garage" she goes! Here, ground crewmen often work all night to ready planes for the next day's operations—a small part of the continual activity aboard Mighty Middy.

Electric Pin Boys *Never* Go Home

A MAN who wouldn't give up after everyone else had failed has produced what bowlers the world over have wanted ever since the game was invented—a machine that will "spot" tenpins on the alley.

With Fred Schmidt's automatic pin spotter, a bowler can spill the maple 24 hours a day if he wants to, and the machine will set 'em up, rake off the deadwood, and return the ball with the regularity of the tides. It distinguishes between strikes and spares, and can even be equipped to call fouls. Furthermore, it protects itself from balls thrown wildly. Unlike pin boys, this robot never has to go home. It is being manufactured by the American Machine and Foundry Co., and will be seen in action this month at the American Bowling Congress tourney in Buffalo.

It is as fast as the best pin boys—7½ to nine games an hour can be played with it—and finicky bowlers can rest assured that no hands but their own will even touch the ball.

The pin spotter operates electrically, mechanically, and by suction. An electrical switch starts the two cycles of the machine in operation, one after the first ball is thrown and the other after the second ball. A ½-horsepower motor hoists the ball to the return track; sweeps the alley bed clear of pins; spots a new set of pins; gathers up the dead pins, and, using them as a reserve set for the next frame, racks them for delivery to the alley bed, and lifts the machinery clear of the alley for play. Suction cups pick up spare pins by their heads and replace them after the deadwood has been cleared out of the way.

An extra feature of the machine is the flashing of a signal that means a player has crossed the foul line. A judge also can

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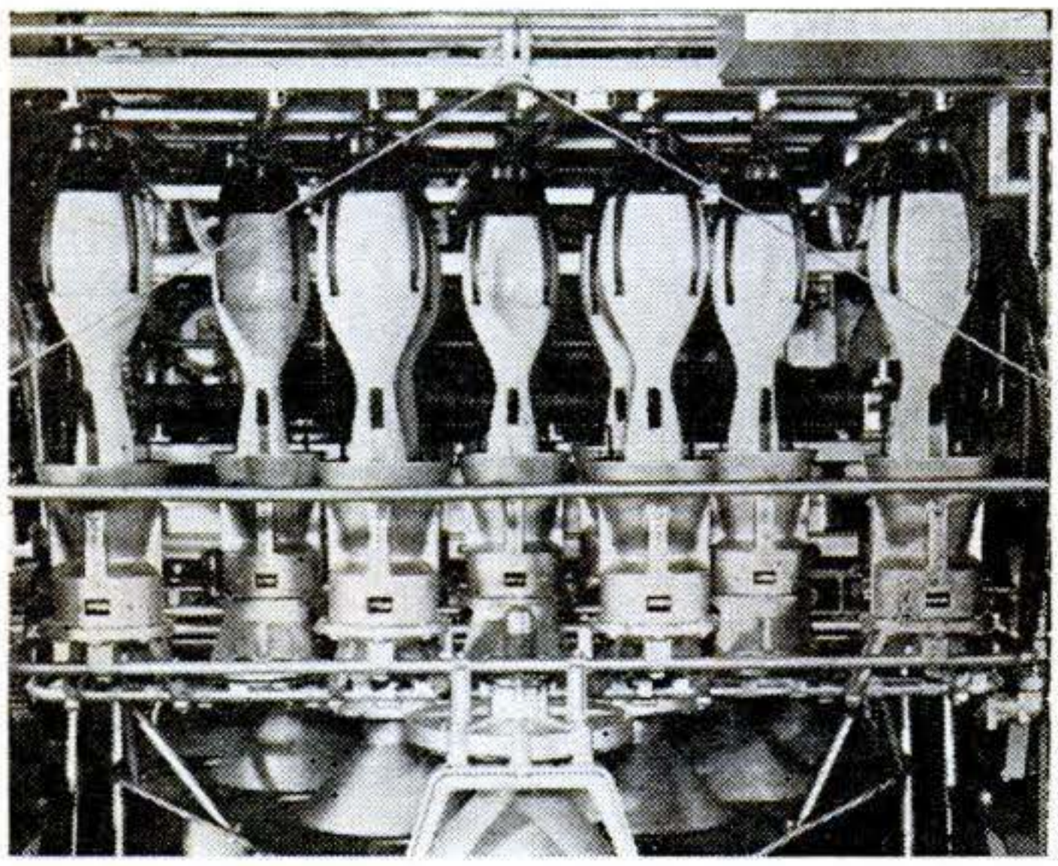
call a foul merely by pressing a button. Schmidt knew that his idea for the pin spotter was not perfect until he hit on the suction pickup. The cups "float" on a platform. That permits them to pick up pins that are off spot. While this is being done, a guard rail is laid across the alley by the machine to fend off any delivered balls.

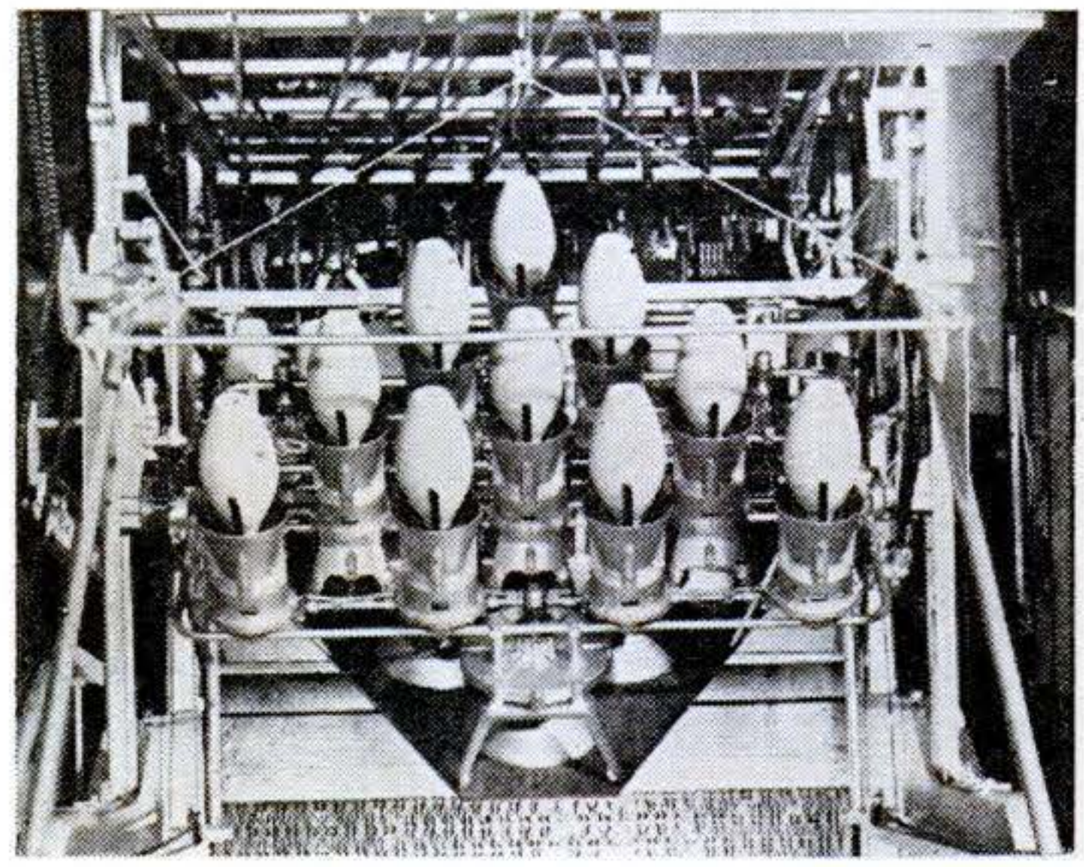
Schmidt worked on the pin spotter for a decade before he made it do exactly what he wanted. He was not satisfied until he could draw a pencil line around the base of a pin and watch the machine replace the pin with an accuracy of hundredths of an inch. Previous to the time he began trying to devise a pin spotter, other inventors and engineers had been trying to make one for thirty years.

They encountered sundry troubles, but most of them had to do with respotting. Then Schmidt hit on the suction idea. His first machine was set up in a farm building that had been used to house turkeys, and was made, in part, out of ten-cent-store lamp shades and those cone-shaped metal containers used for graveyard flowers.

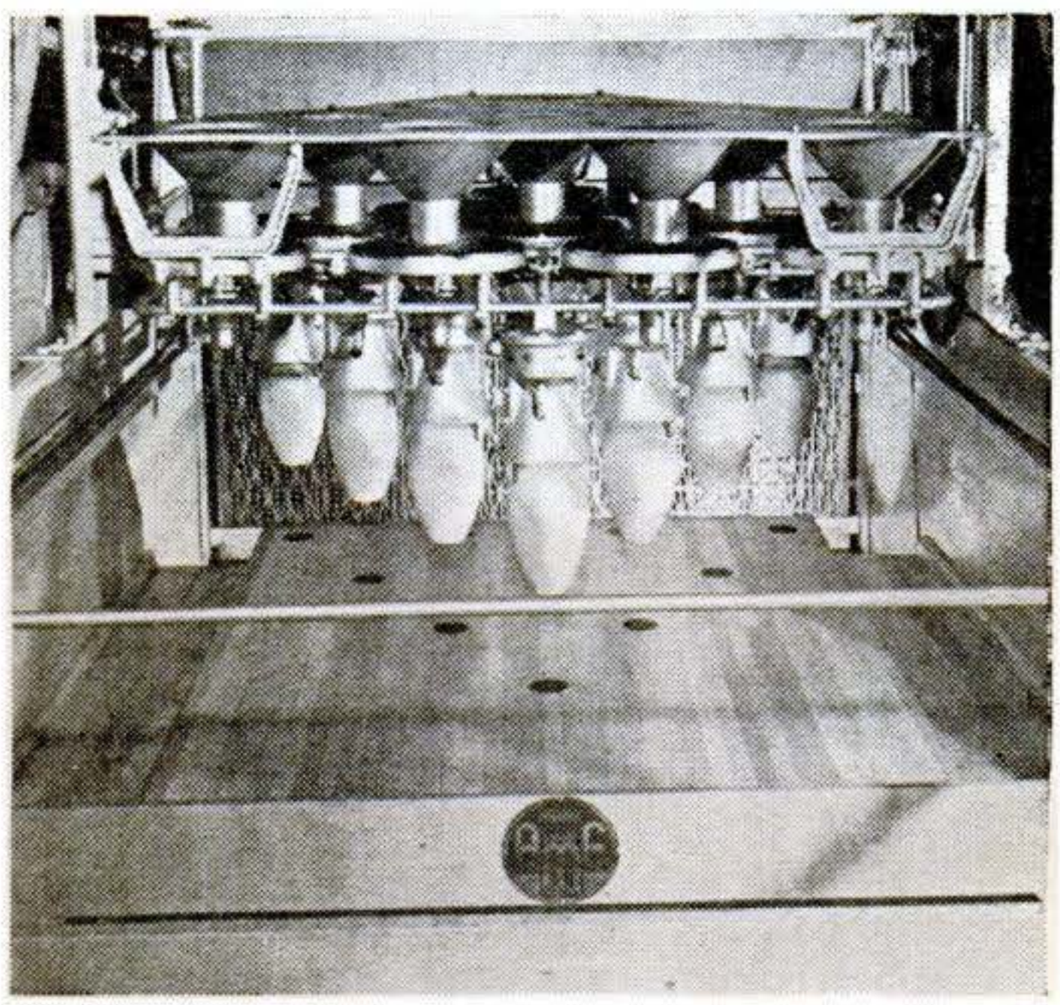
HOW THE PIN SPOTTER SETS UP TENPINS FOR NEW FRAME



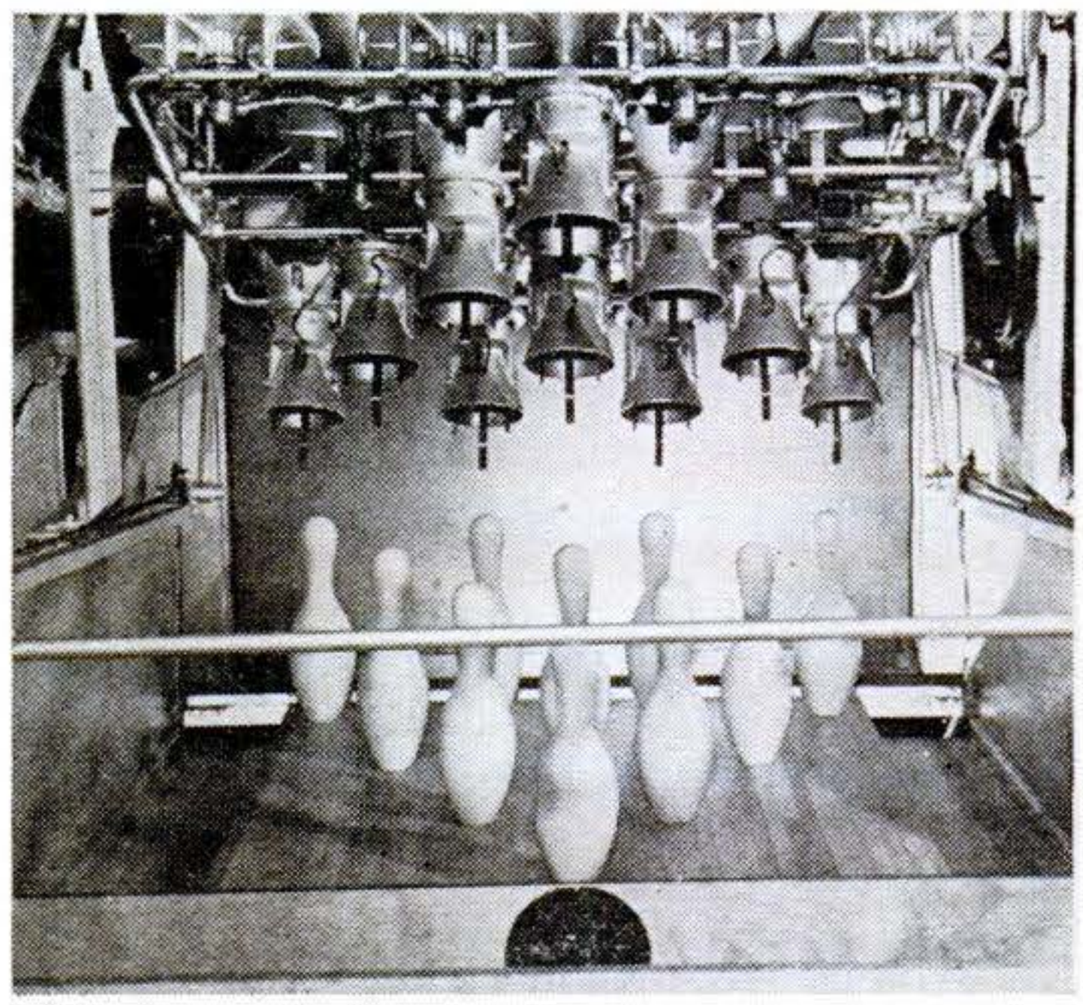
1 Pins are carried by a conveyor to a "loading station." Spirals place pins in line, ready to be picked up by monorails (top of photo) and set in suction cups of the turntable. Machine uses two sets of pins, keeping one ready to be set up.



2 With tenpins firmly fixed in suction cups, the deck of the turntable is turning head pin over back row to deposit pins on the bed of the alley. Pin spotter is actuated by a switch that is thrown when bowler's ball lands in pit behind the pins.



3 Down come the pins, and they'll be set exactly on the ten spots—more expertly than any pin boy could put them in place by hand. Guard rail (bottom of picture) fends off wildly thrown balls.



4 Pins are in place. Contact with the floor of the alley broke the suction holding the pins in the cups, leaving them perfectly aligned. The machine rises clear of the alley, and play can begin.

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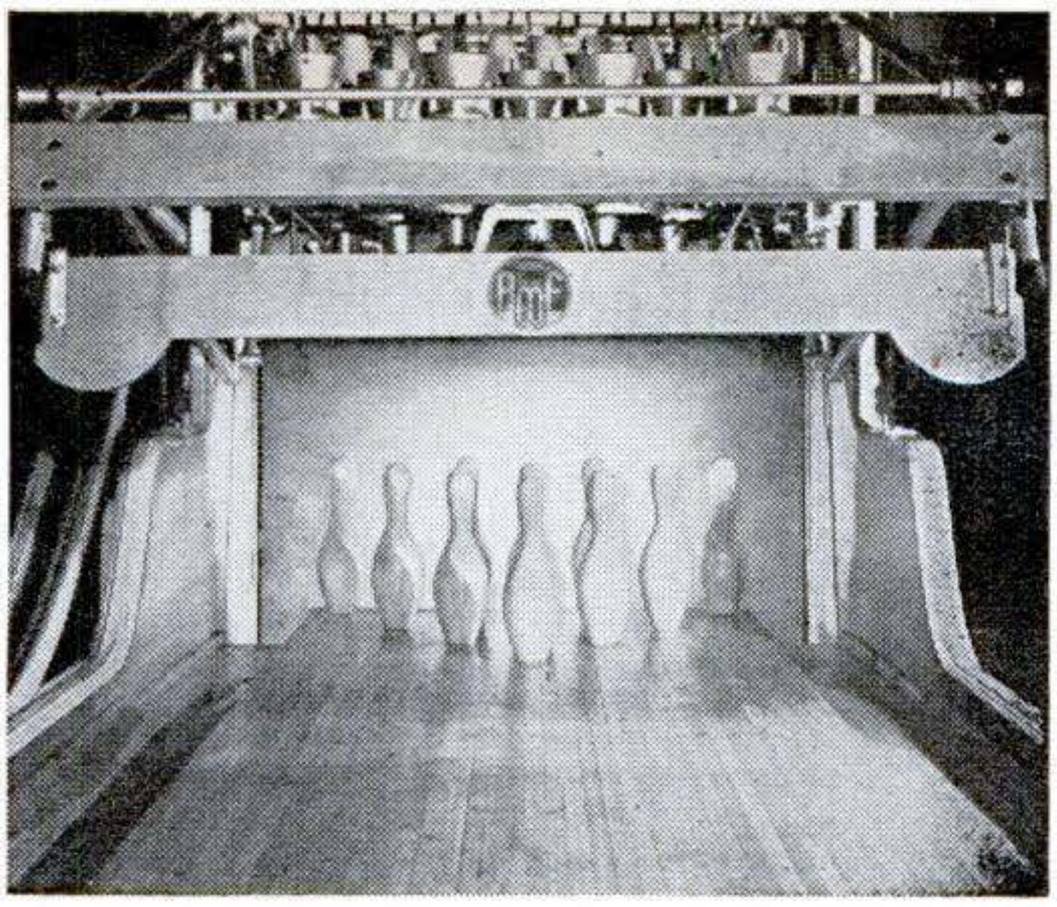
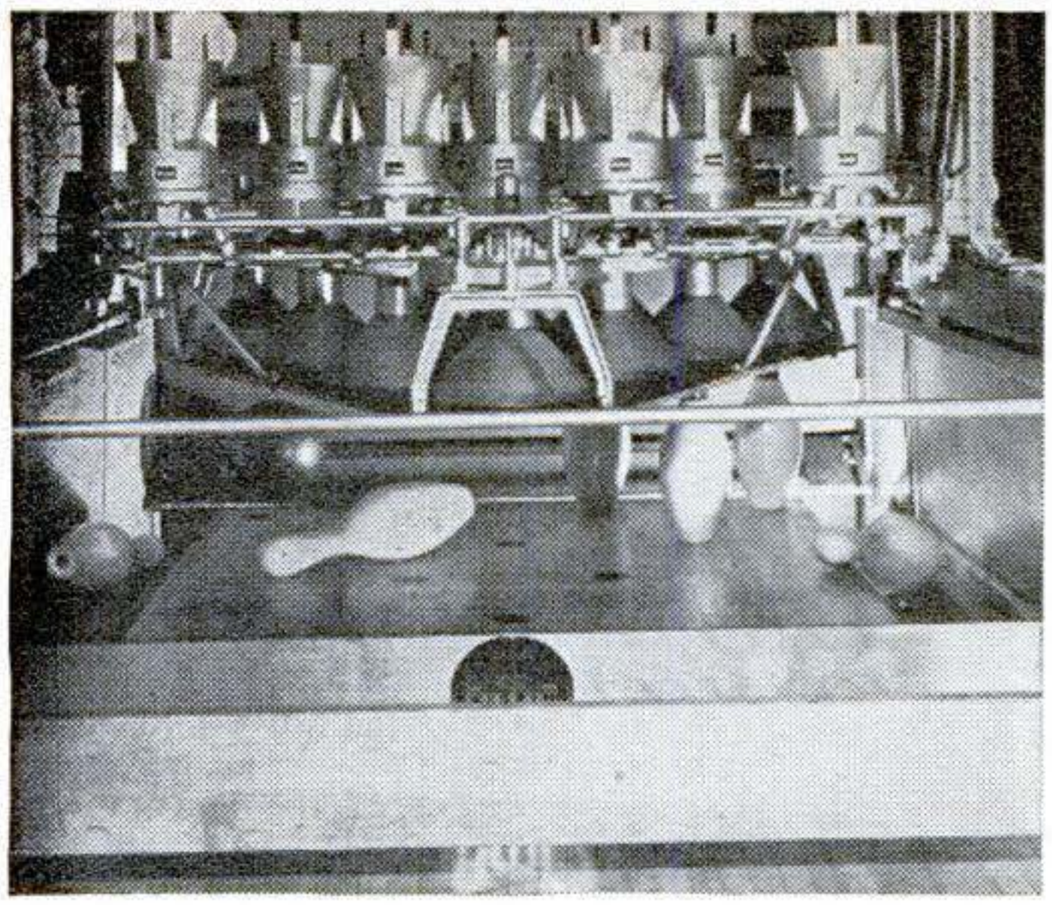
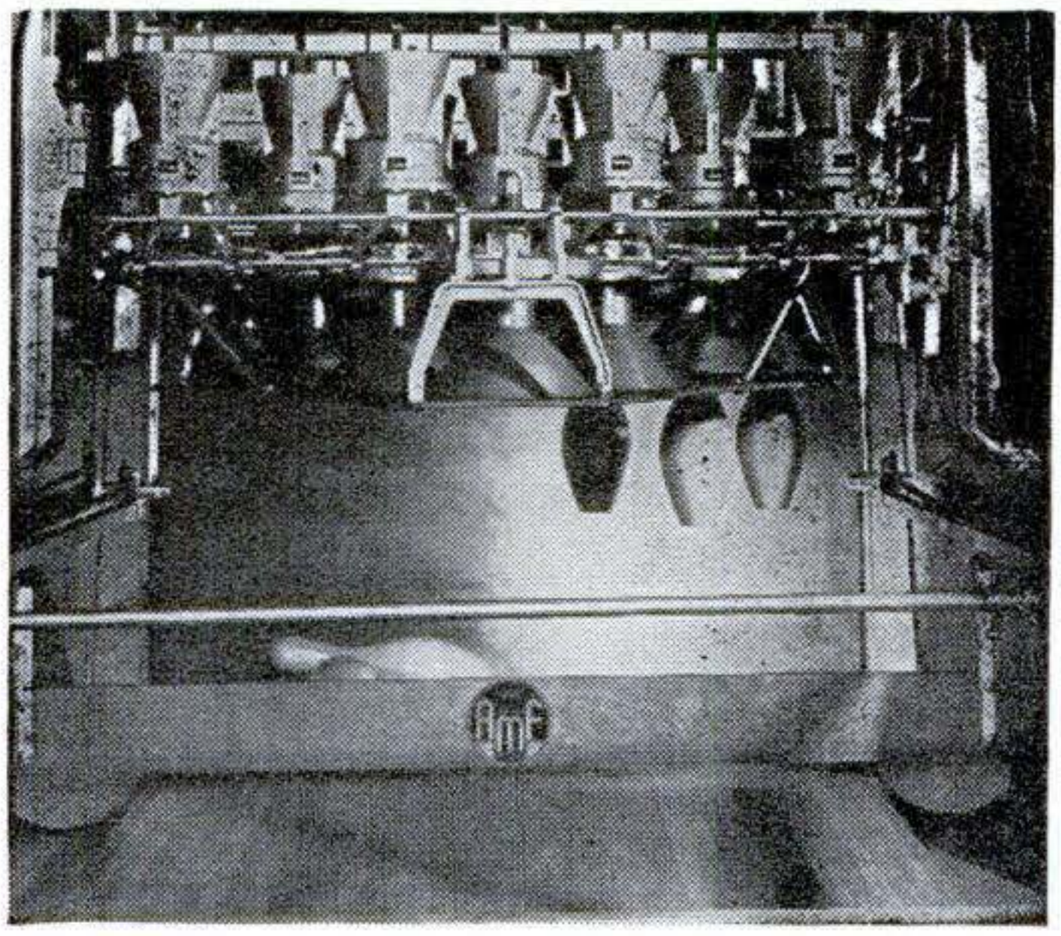
HOW THE PIN SPOTTER CLEARS DEADWOOD, RESETS PINS



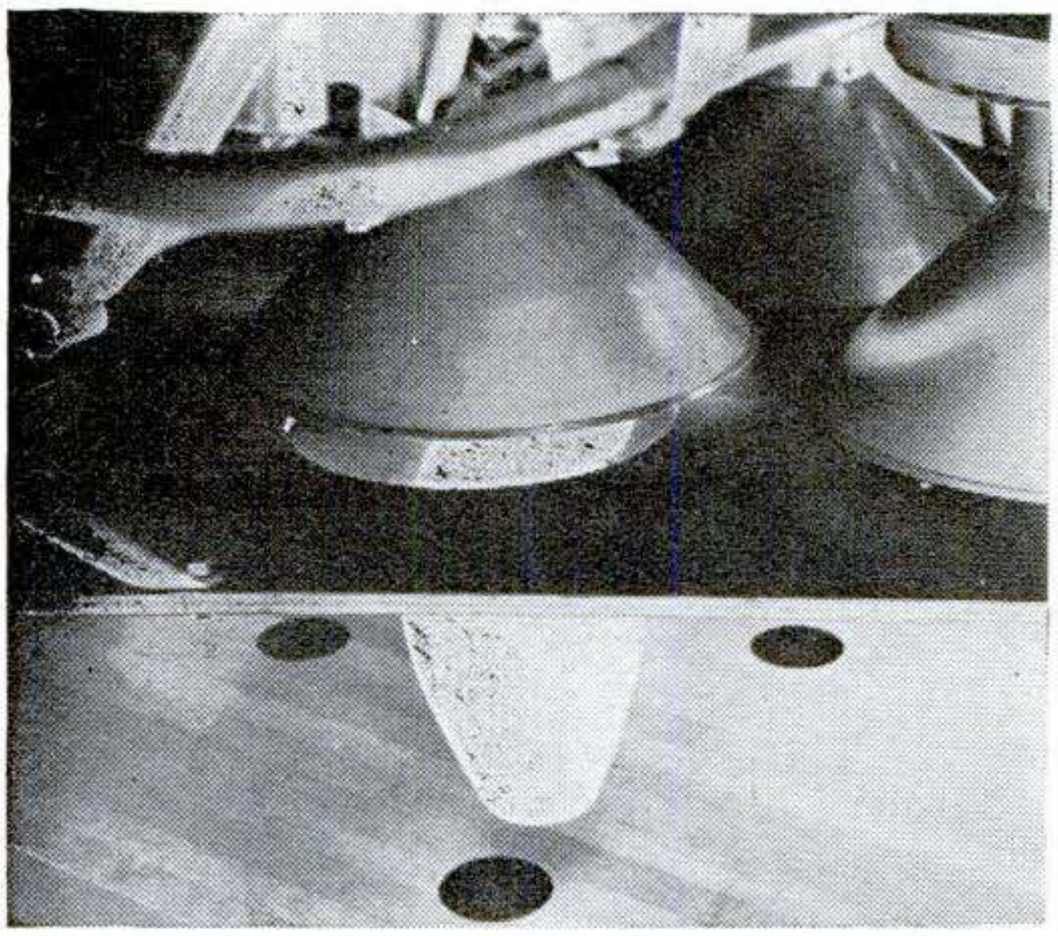
1 This is how the far end of the alley looks to the bowler before he rolls his first ball. The machine can be installed on any regulation alley; no alterations to the pit or alley are required.



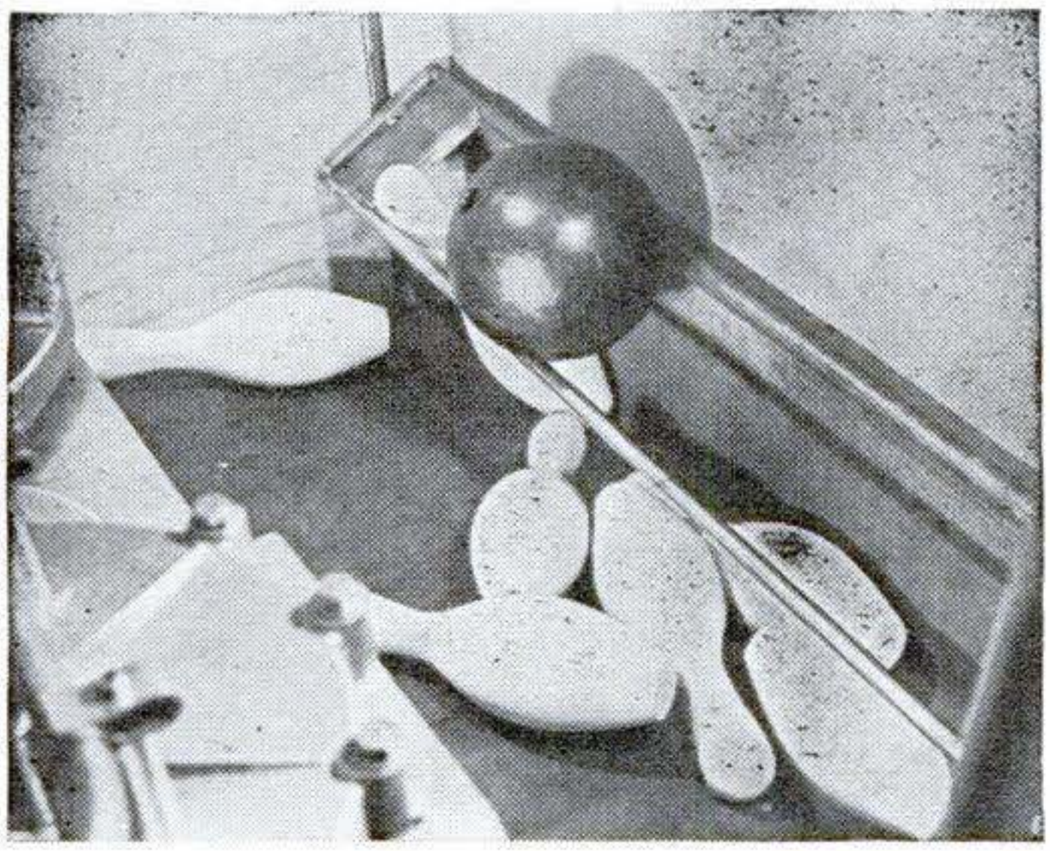
2 Bowler has delivered his first ball, leaving three pins standing. Three deadwood pins also remain on alley. Ball pickup is returning ball, as machine descends to clear alley for next ball.



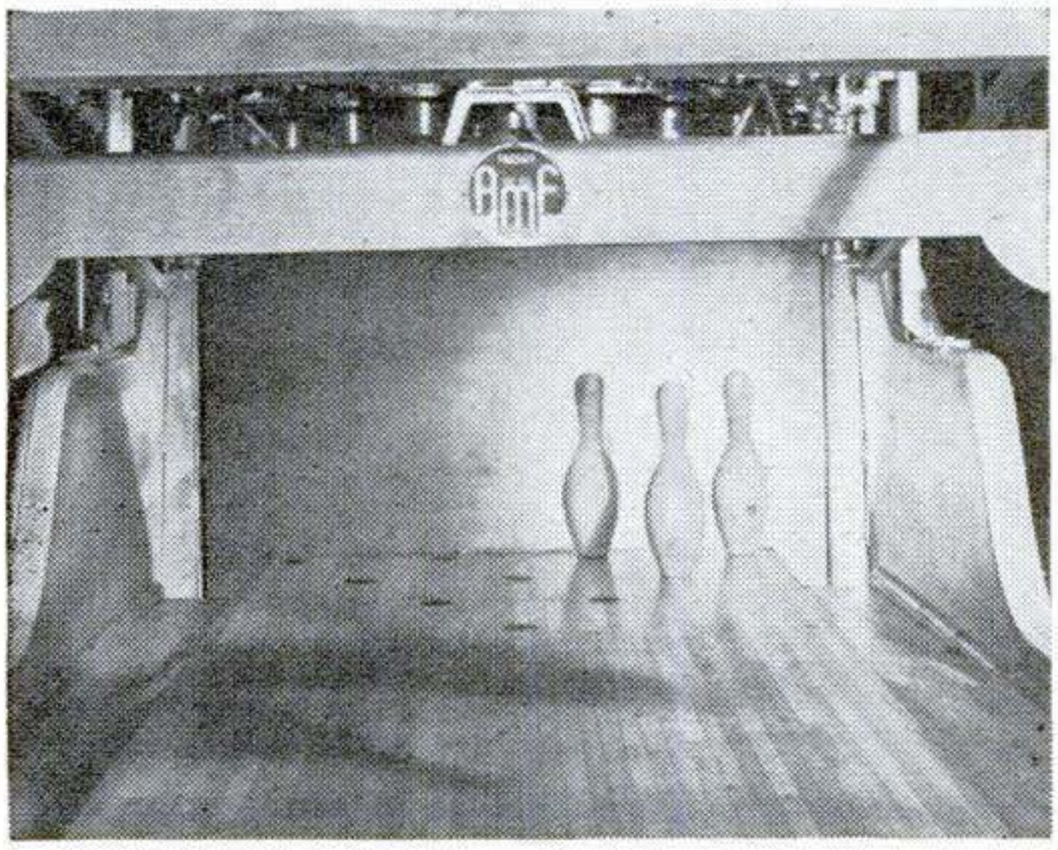
3 Lamp-shadelike suction cups that "float" on the underside of the turntable to fix their positions to those of the standing pins have picked up the pins; a sweep board clears away deadwood.



4 Sweep has operated, and here the pins that were standing are returned to the exact spots where they were picked up. First ball merely brushed pin in foreground, so it is reset that way.



5 With not a hand touching it, the pickup positions the ball on the return rails. Deadwood pins then are delivered to spirals for next frame.



6 The first cycle is completed, and the alley is now ready for the bowler to roll his second ball. Machine complies with all rules of the A.B.C.

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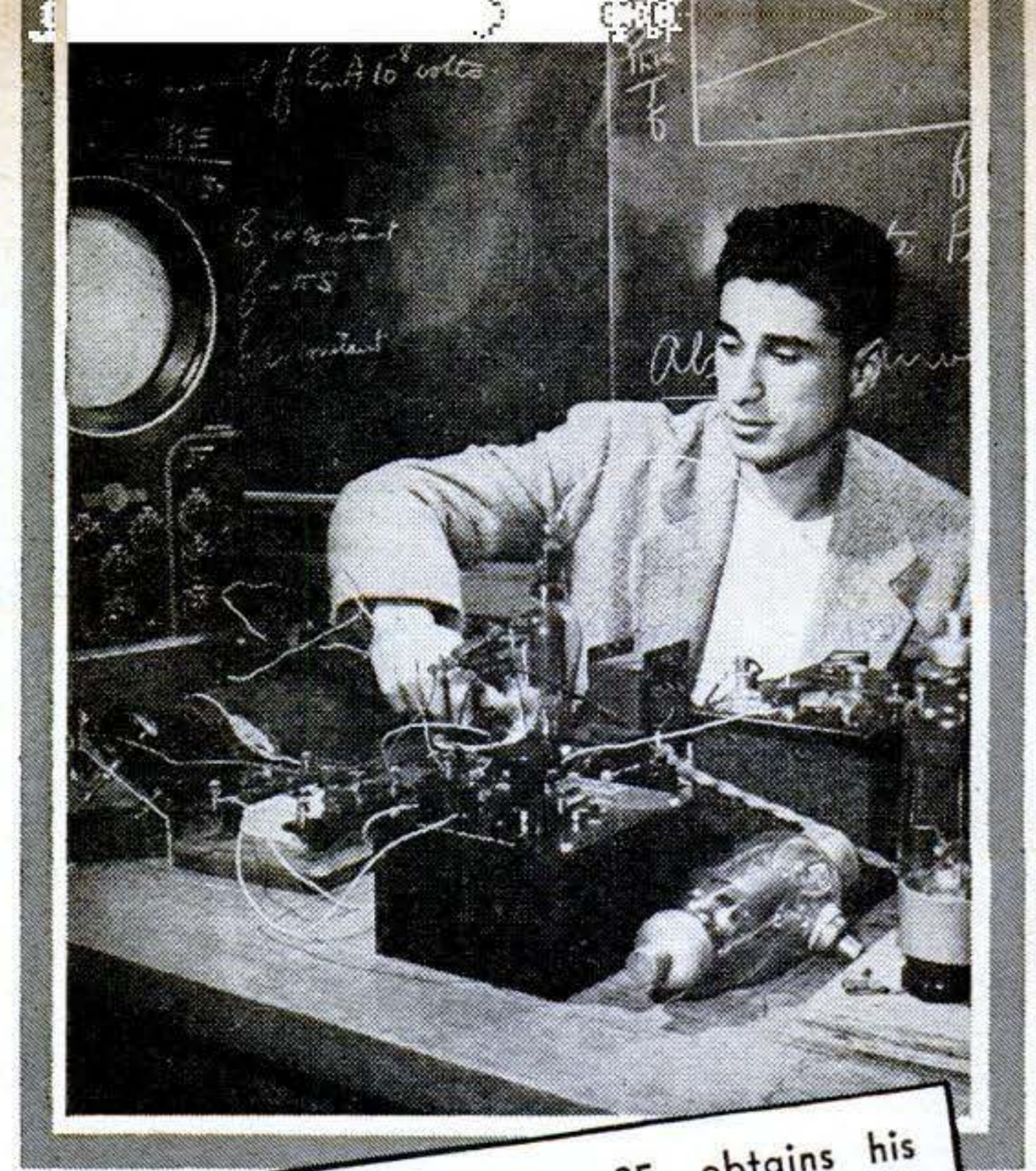
Before Stanley Daly, 24, can gain a doctorate, it will be 1952—14 years after he started college. He had studied at Columbia for three years before he was inducted in 1941, but has changed courses since his return. He lost nearly four years serving in New Guinea.



When Harold Kirchblum, 25, obtains his doctor's degree, it will have taken him 10 years. During the war he flew Liberators, was shot down and imprisoned. He had had two years at N.Y.U. when inducted in 1942; resumed his physics research last October.

LOST: A Generation

By LEON SHLOSS

Fundamental scientific research is at a standstill in America. That is the harsh fact of a matter that has been hushed and avoided too long. The cause is a literal interpretation of democracy that has yanked 150,000 men out of scientific studies to make a scant two percent of the total armed forces.

More than 15,000 of these drafted science students by now would be working toward their doctorates if they were British or Russian. But being Americans they were drafted. Also kidnapped by the armed forces were many brilliant practicing scientists who happened to be young and healthy. And unless Congress has been unusually alert in the few weeks it has taken to print this magazine, our present and future scientists are *still* being drafted, although trolley cars are running again in the ruins of Nagasaki.

Both Britain and Russia realistically kept their science-minded young men in the laboratories and classrooms. We tried to treat all young men as equals, squandered our best young brains for the sake of their bodies. The scientist of 1953 was sacrificed to put a shoulder under a Garand in 1943.

Meanwhile, applied science—the adaptation of principles to practice, visible in better cars and washing machines—has been hit equally hard. Industrial laboratories are having a tough time recruiting smart young men because so few are coming out of the colleges. And, of course, the draft boards call up young scientists from corporations as heedlessly as from universities.

Right now, this country is living off its scientific fat. The many scientific achievements of the war were based on knowledge attained through fundamental research done in the years before the war. The nation's scientists, split as they may be on other issues, agree that this is a grave situation. In the atomic age, it could mean the end of the United States as a first-rate power.

Dr. Vannevar Bush, director of the Office of Scientific Research and Development, says: "In peace or war the handicap might

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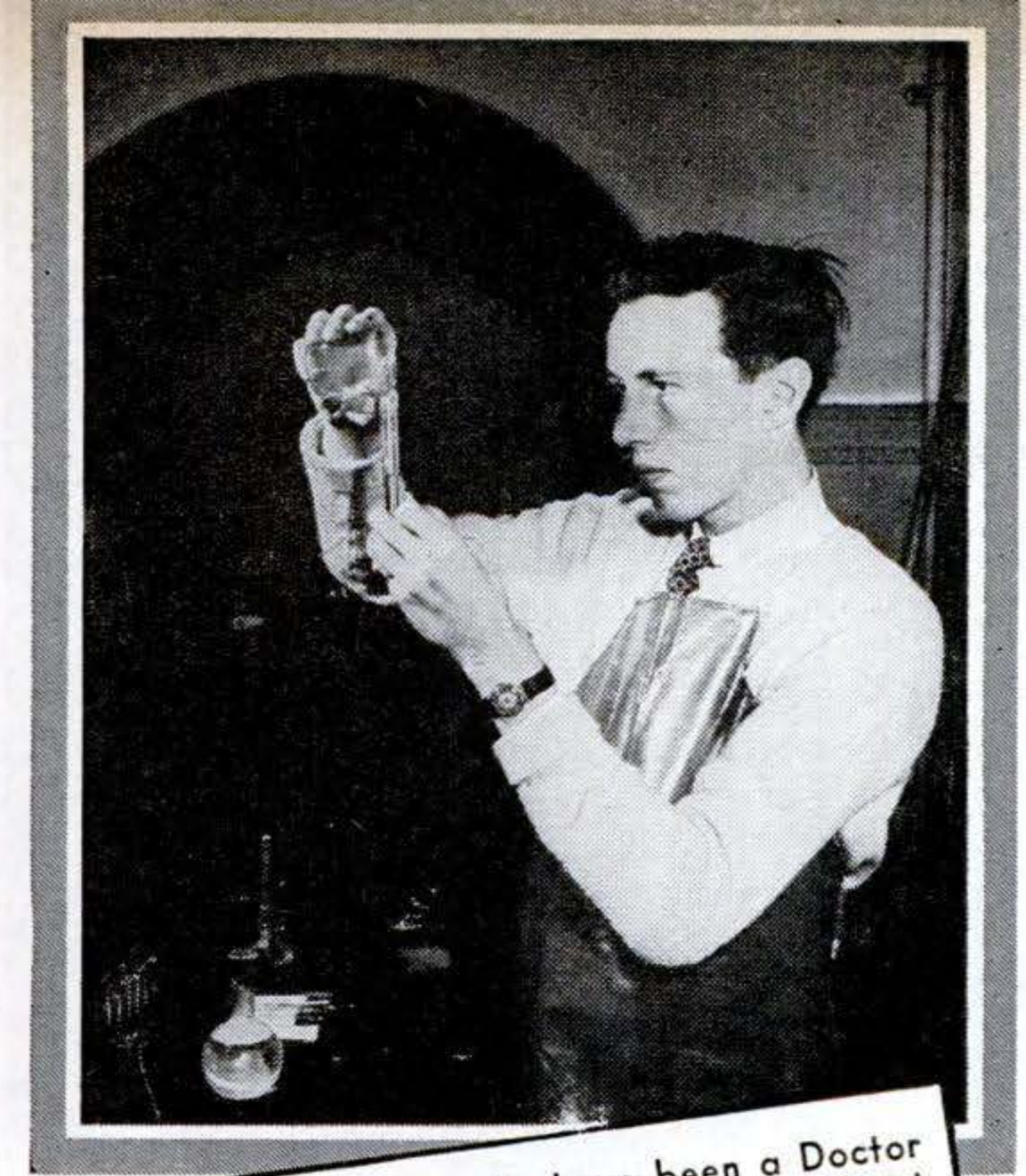
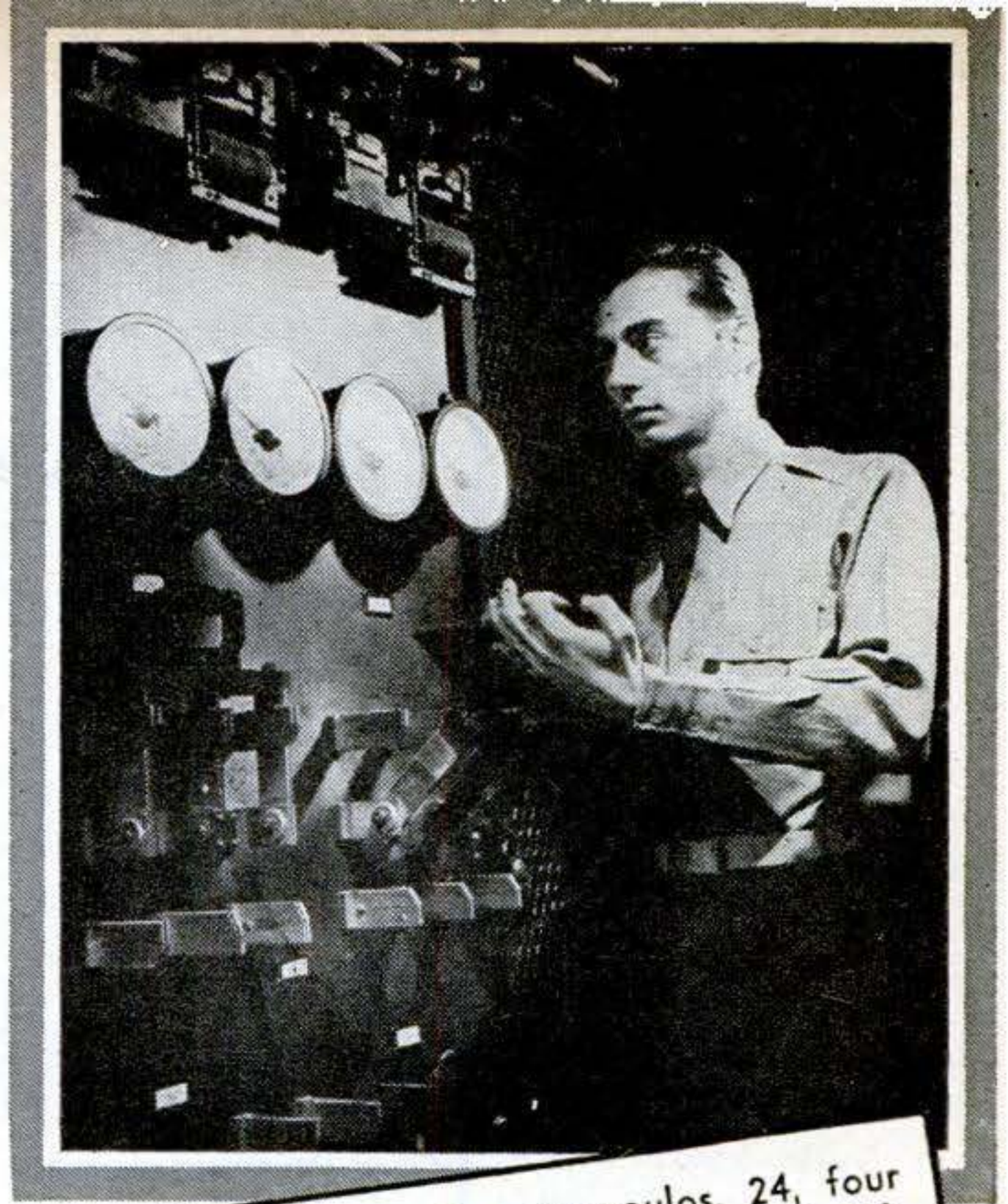


Richard Pott, 25, might have been a Doctor of Science today. Instead, it will be at least 1950 before his training for fundamental research will be complete. Pott was an officer in the South Pacific, but lost 4¾ years in which he might have been studying chemistry.



It will take James Demetropoulos, 24, four more years to earn his doctorate in electrical engineering. He knew he would be drafted so, after two years of science study, he enlisted. He became a pilot and won the Air Medal, but was out of school 3½ years.

Photos by HUBERT LUCKETT

prove fatal to our standards and to our way of life."

Dr. Harvey N. Davis, president of Stevens Institute of Technology, says: "Obviously we shall never have even such precarious security as armed preparedness can give unless our technically trained civilian personnel is more numerous and able than that of any possible aggressor."

Rear Admiral Lawrence B. Richardson, assistant chief of the Navy's Bureau of Aeronautics, says: "Fundamental research in aeronautics is more important now than it has ever been."

Dr. Laurence A. Hawkins, consultant of General Electric's research laboratory, says: "The newly invigorated spirit of research will be restricted by lack of man power, for it would be as foolish to attempt a research project with untrained men as to entrust a full-rigged ship to a crew of landlubbers."

But for the war, most of the 150,000 men in the Lost Generation would now be seeking knowledge that would lead to new cures for disease, new products for industry, better living conditions, and new weapons to assure military security. Instead, the records show, they are either trickling out of the armed forces, two to five years behind in their studies, or still serving. Thousands of them, for economic reasons, have been or will be forced to abandon education in favor of immediate employment.

Even if every possible remedial step were taken immediately, it would be 1955 or 1960 before this country could catch up in scope of research activity with Britain and Russia. Russia, where the number of higher educational institutions was increased from 91 to 782 in 20 years, opened 60 new colleges during the war.

The basic knowledge from which came the remedies—penicillin, sulfonamides, DDT, new vaccines—that cut the disease rates between World Wars I and II from 14.1 to .6 per 1,000 men was discovered *before* the last war, not during it.

The world attached scant importance to the epochal discovery in 1896 that certain elements emitted rays—radioactivity is the word today. But thousands of lives were saved in World War II by that single piece

# of SCIENTISTS

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of new knowledge. Certain battle injuries were found to require immediate transfusion with whole blood, but whole blood could be stored safely for only five days. The armed forces called for a preservative solution in which whole blood could be kept for 21 days. Using radioactive isotopes of iron and electric counters, which had been invented to count particles as they disintegrated from radioactive atoms, science delivered. The isotopes were used to "mark" blood that subsequently was transfused. Then the scientists counted the radiations emitted and were thus able to measure the survival of transfused red cells in different preservatives. Inferior preservatives were screened out and one that more than met military requirements was obtained.

Men who were preparing to continue such fundamental research were forced to abandon their studies for the duration—which jeopardizes our future.

There are plenty of examples of science-drafting that emptied lab benches from which might have come momentous discoveries. In the National Advisory Committee for Aeronautics, where all fundamental federal aviation research is carried on, more than 500 men were drafted before an appeal to the White House brought about an arrangement to protect NACA's professionals, most of whom were reservists. But when the war ended, the Army told NACA that it intended to call all reservists over 26 to active duty. This meant police work in foreign countries for two years for more than 600 men, 40 percent of the entire professional staff. The act itself has been staved off until March 31, but nobody knows what the next move is.

The Administration, Congress, Selective Service officials and the draft boards could have prevented loss of this generation of scientists by insisting on screening candidates for induction, and placing those with scientific backgrounds or promise at their proper battle station—the laboratory bench. All hedged, fearing public repercussion. The truth that some boys are more ideally suited to a test tube than to a trench was ignored. Finally, in November 1945, draft regulations designed to remedy the situation were issued, but they failed to prevent drafting of the science-minded student at the very time he is entering college.

Legislation that might have solved the problem was snarled for months, is still at this writing tied in a Gordian knot of Congressional proportions. Recommendations for establishment of a National Science Foundation, which would place 6,000 young people in science study each year until 24,000 are in college at all times, were embodied in a bill introduced by Senator Warren G. Magnuson on July 19. Senator Harley M. Kilgore, who sponsored a science mobilization bill as far back as 1942, four days later introduced a science foundation bill, varying somewhat from the Magnuson bill, but also providing for training of young scientists. More than 100 eminent witnesses urged passage of legislation. Then proponents of the bills started a dog fight, chiefly over whether the Foundation should be run by a governing board (Magnuson) or by a single administrator (Kilgore).

Scientific and industrial organizations did their best to mitigate the drain on our scientific reservoir, but they could plug only a few holes at a time. Industry implored draft boards to spare scientists; provided many scholarships for available students.

Ten organizations affiliated with the American Association for the Advancement of Science now have a plan to stem the tides if compulsory military training is initiated, a plan to test all youths for scientific aptitude and assign those with promise to technical training. This training would cost only about half what military training costs.

In the meantime, virtually all scientists agree, blanket deferment from the draft should be granted to all scientists and science students. If all the scientists under 26 who have been doing research work on war projects were deferred to continue scientific work or study, the Army would lose the services of only 6,000 men.

Next, all scientists and science students who have already been drafted should be released to resume their work.

Putting 24,000 young people into science schools, as has been proposed, would cost no more than one aircraft carrier loaded

MILITARY TRAINING NEED NOT PARALYZE SCIENCE

Present legislative proposals for compulsory military training, if enacted into law, will inflict the same paralysis on scientific progress that the draft did, by interrupting the studies of young scientists.

The editors of *Popular Science Monthly* are convinced that this must not, and *need not* happen. Science can carry on its vitally important work—and do its duty in military training, too.

Why won't a summer vacation, plus one night a week, devoted to military training give any young scientist the principles of organization, physical training, and simple shooting? The basic training period in World War II was cut from 13 weeks to 10 weeks, and then to 6 weeks.

And the enemy was using *live* ammunition then.

The Editors

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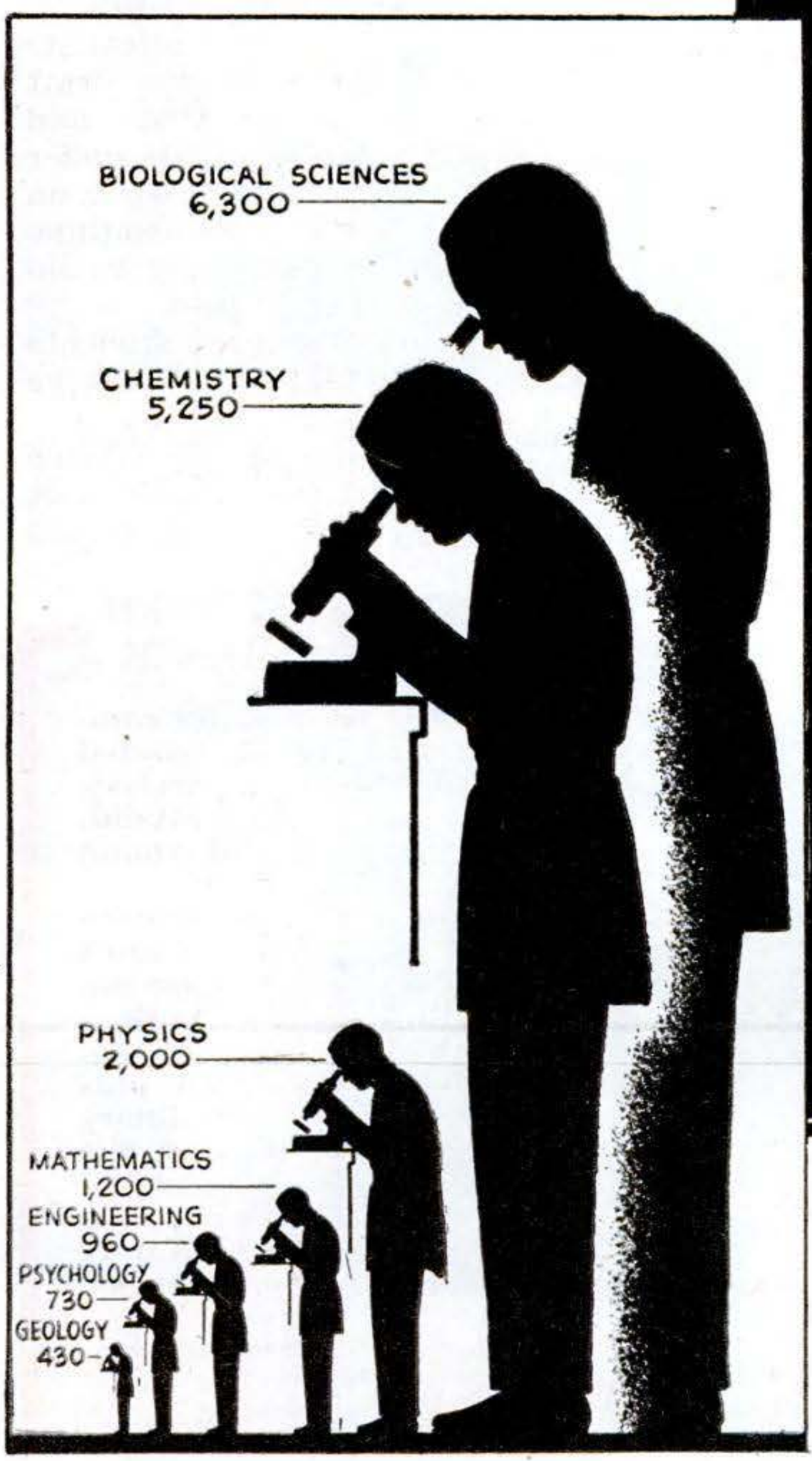
with atom bombs, and the nation's need for scientists is urgent.

A large number of hybrid Ph.D.s who can bridge the gap between physics and other scientific fields must be created. These key men in future research teams can help regain some lost ground.

The atomic age demands vast multiplication of fundamental study. The money cost may be large, although science itself talks only in millions. Establishment of a National Science Foundation would assure federal financial support of fundamental research. Applied research must have federal help, too, but it will pay part of its own way as it solves its own problems.

A quarter of a million young people must be gotten into scientific study at once. This is a minimum "must".

It is a "must" if we are to acquire what we must have to unlock further secrets of the atom: two or three scientists working where only one worked before the war.



America's loss was incalculable when 150,000 of her scientists and science students (charted above) were drafted, but the gain to the armed forces was trivial. Approximately 15,000 students might have obtained their doctors' degrees by this time if they had not been drafted. Personnel losses to various branches of advanced science are indicated in the drawing at left.

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GERM Weapons Were Ready

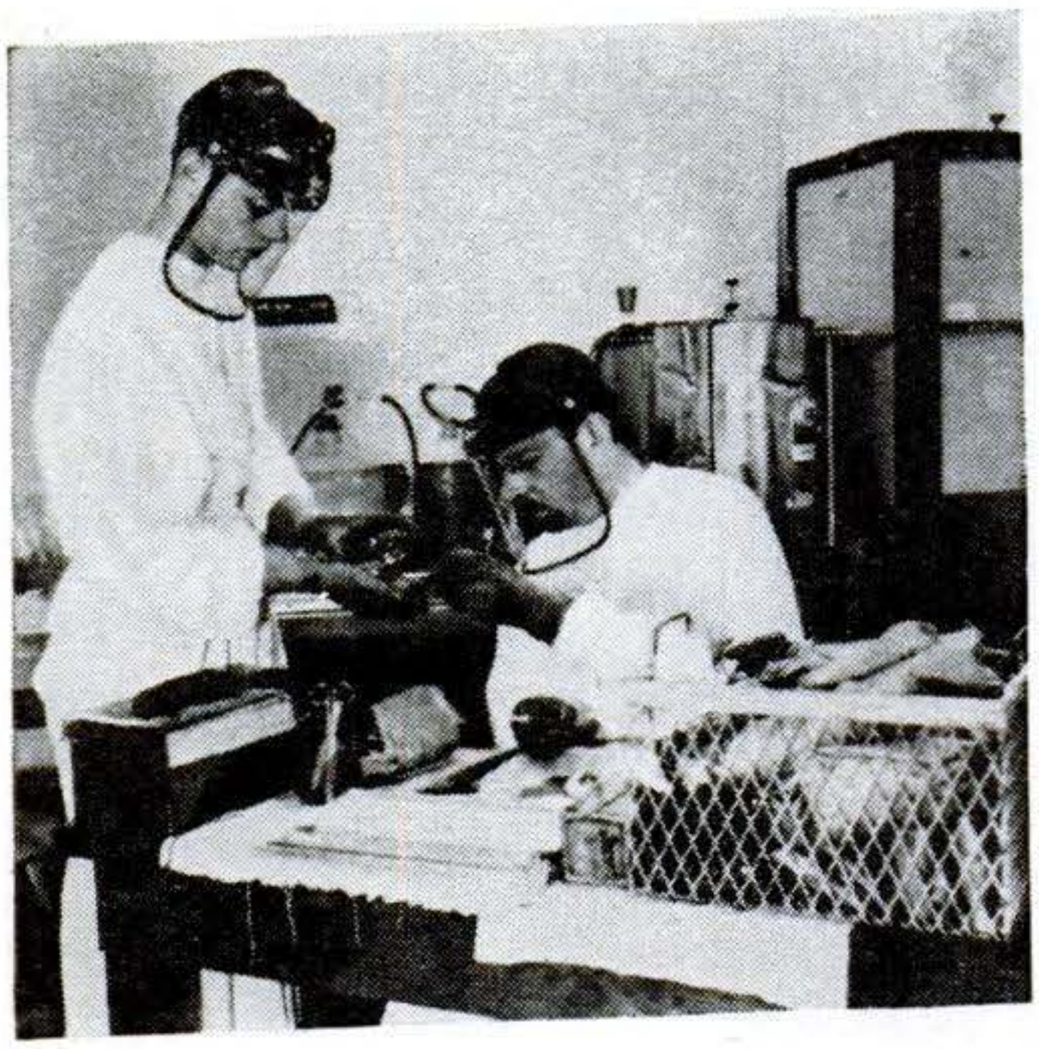
A SECOND weapon almost as terrible as the atom bomb was ready at the American hand when the Axis capitulated—bacterial warfare. A two-edged weapon, it might have prevented its users from occupying conquered countries for years—for plagues and pests recognize no surrender.

The Army has disclosed that nearly 4,000 persons were engaged in preparing offensive and defensive bacterial weapons. We were well prepared to fight with bacteria, fungi, viruses, rickettsiae (micro-organisms that cause trench fever, typhus), and toxic agents from living organisms. Immediate peacetime applications can be expected from the intensive research into cause, nature, and cure of diseases in man, animals, and plants.

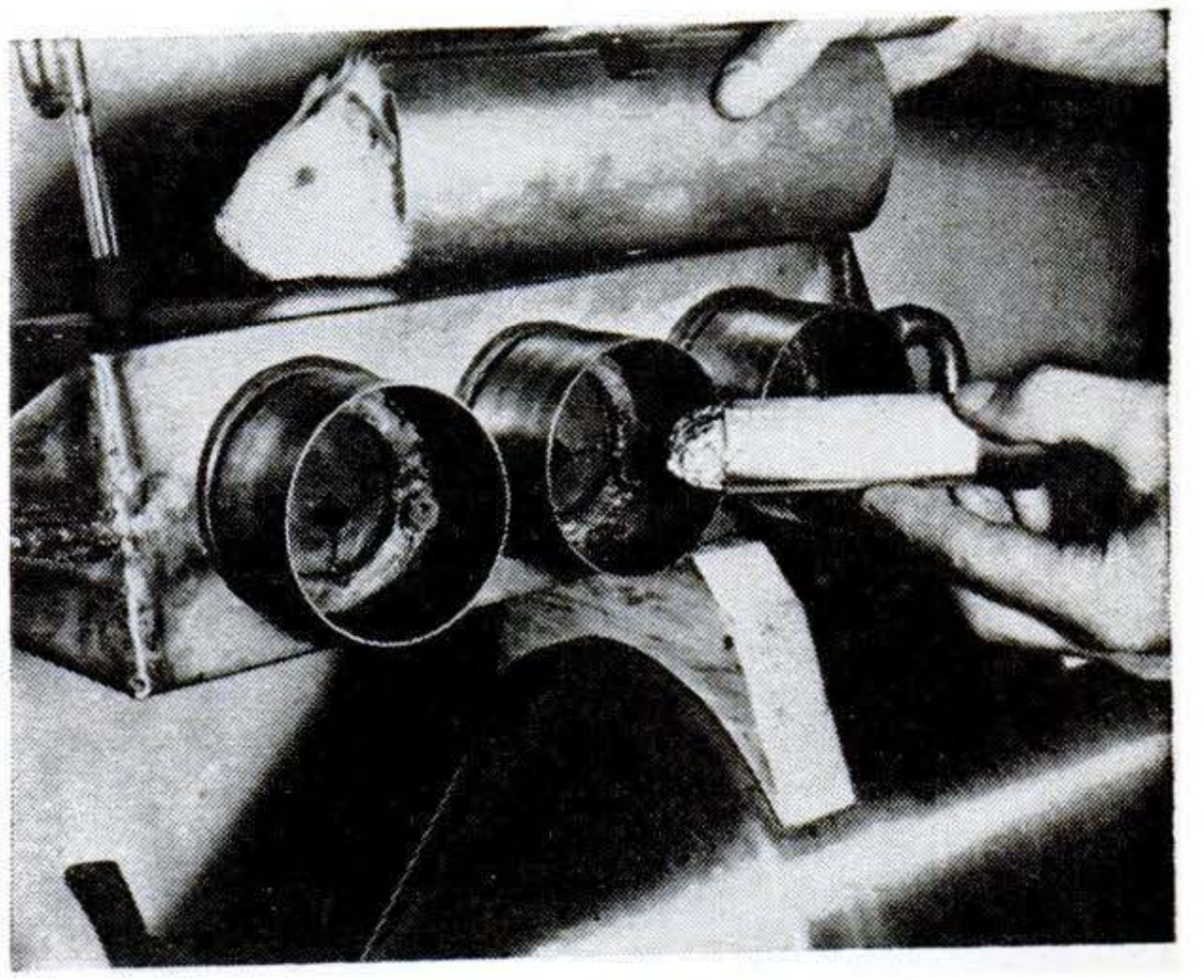
If the Jap had put up the expected fanatical, last-man resistance, his food crops might have been ruinously bombed with fungus spores to starve out resistance. Rice, sweet potatoes, and soybeans are vulnerable to several fungus diseases.

Bacterial-warfare planning could proceed under the guise of research even more deceptively than atomic-bomb study. Bacterial scientists, like their physicist fellows, are demanding full publication of pertinent findings, and an international inspection system, to permit interchange of information for the benefit of humanity and to preclude surprise devastation by possible aggressors.

"Man from Mars" was the almost inevitable nickname for anyone wearing the rubberized protective suit made for Navy personnel who studied possible enemy uses of infectious diseases as war weapons.



Performing an autopsy on one of the animals infected during our development of new viruses and means of spreading them.



Animals were exposed to many infections. Placed in metal tubes, they were inserted in the Reyniers apparatus where they breathed air laden with germ cultures. These are official U. S. Navy photographs.

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RADAR *reaches the Moon*

USING vastly more power than was ever utilized to probe the sky for enemy planes, man beamed radar waves at the rising moon a few minutes before noon on January 10, 1946—and in 2.4 seconds received a feeble response for the first time. In loudspeakers it was a 180-cycle note, a little higher in pitch than the hum of a poorly tuned home radio; on oscilloscopes it was a jagged hummock of light.

The historic pulses of energy that bounced off the whirling moon and echoed back to a small shack on a hilltop near the coast of New Jersey made a round trip of about 470,000 miles. Unlike most radar waves, sent at the rate of thousands a second, these pulsed outward every three to five seconds and lasted from one tenth to one half a second each. They were beamed on a frequency of 111.6 megacycles. An exceptionally sensitive receiver caught the echo, estimated to have a strength of only three watts.

"Project Diana," as its Signal Corps and civilian workers imaginatively called it, proves that radio waves of very high frequency can pierce the electrically charged ionosphere, which wraps the earth and stratosphere in an invisible blanket 250 miles thick. Proof of this fact set off an excited chatter of speculation about what it may mean to earth dwellers. It should help engineers study the effects of the ionosphere on radio waves. It assures man that he can be warned electronically of hostile missiles that might be rushing towards him through cosmic space. Some persons predict radio-controlled "space ships" that will venture thousands of miles from the earth, reporting what they find out among the stars.

From this antenna in New Jersey, double the size of the usual radar "bedspring," went the waves that bounced back from the moon.

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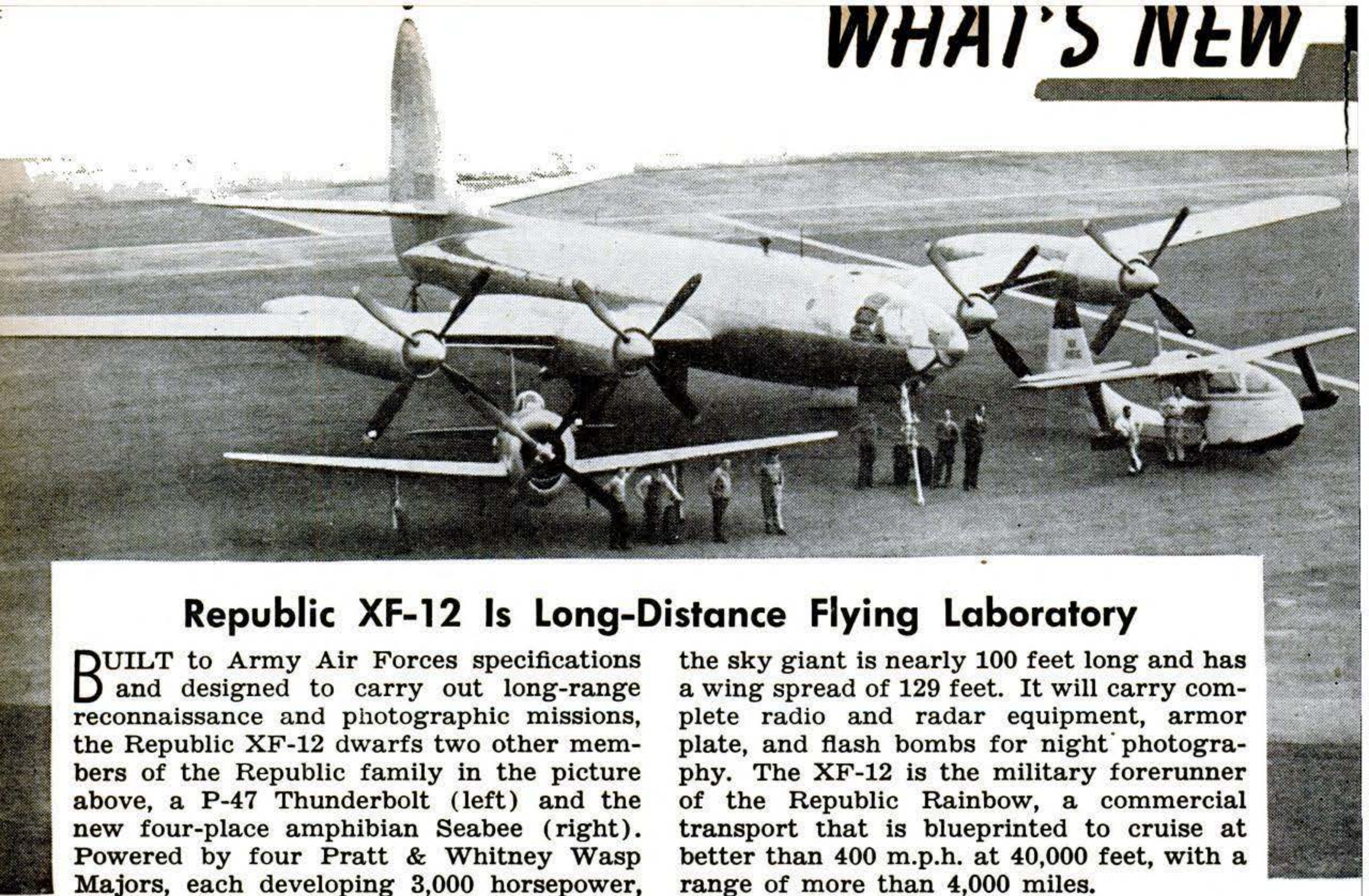
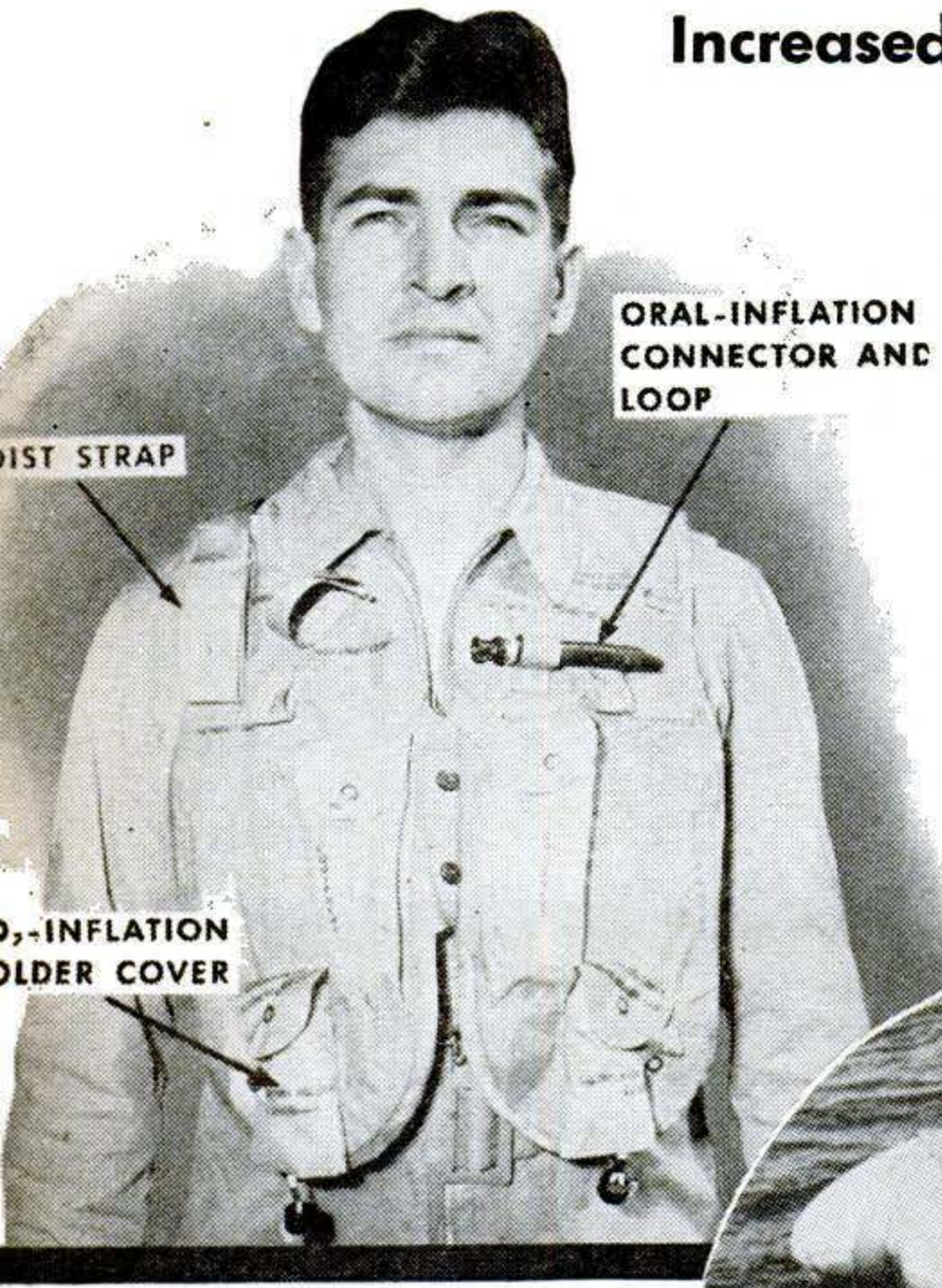


Republic XF-12 Is Long-Distance Flying Laboratory

BUILT to Army Air Forces specifications and designed to carry out long-range reconnaissance and photographic missions, the Republic XF-12 dwarfs two other members of the Republic family in the picture above, a P-47 Thunderbolt (left) and the new four-place amphibian Seabee (right). Powered by four Pratt & Whitney Wasp Majors, each developing 3,000 horsepower, the sky giant is nearly 100 feet long and has a wing spread of 129 feet. It will carry complete radio and radar equipment, armor plate, and flash bombs for night photography. The XF-12 is the military forerunner of the Republic Rainbow, a commercial transport that is blueprinted to cruise at better than 400 m.p.h. at 40,000 feet, with a range of more than 4,000 miles.

Increased Buoyancy Marks New Life Vest

DESIGNED to provide double the 17-pound buoyancy of the present Mae West, the Navy's new life vest of neoprene-coated nylon is also patterned to eliminate discomfort (see photographs below). The vest contains three separate inflatable compartments: inside and outside ones that are expanded by means of CO_2 and a middle one that is blown up orally through an inflation-valve connector.



Deflated (right), vest's neck portion lies as flat as a middy-blouse collar. Inflated (below), it comfortably supports wearer's chin and head.

Storage space is provided for such rescue equipment as flashlight, sea-dye marker, flares, whistle, and other items. Note the hoist sling that makes it easy to fish a person out of water.

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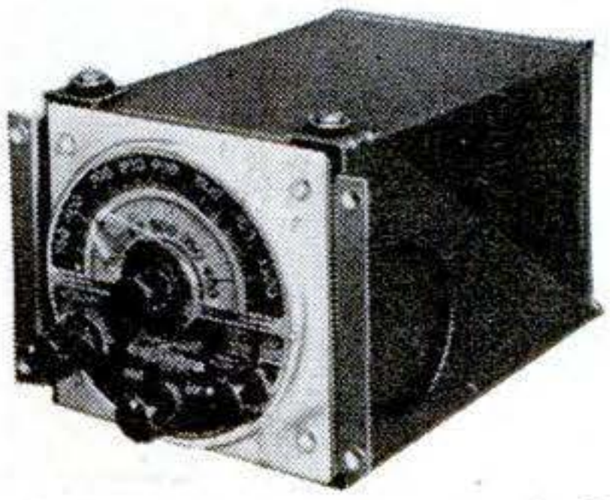
IN AVIATION

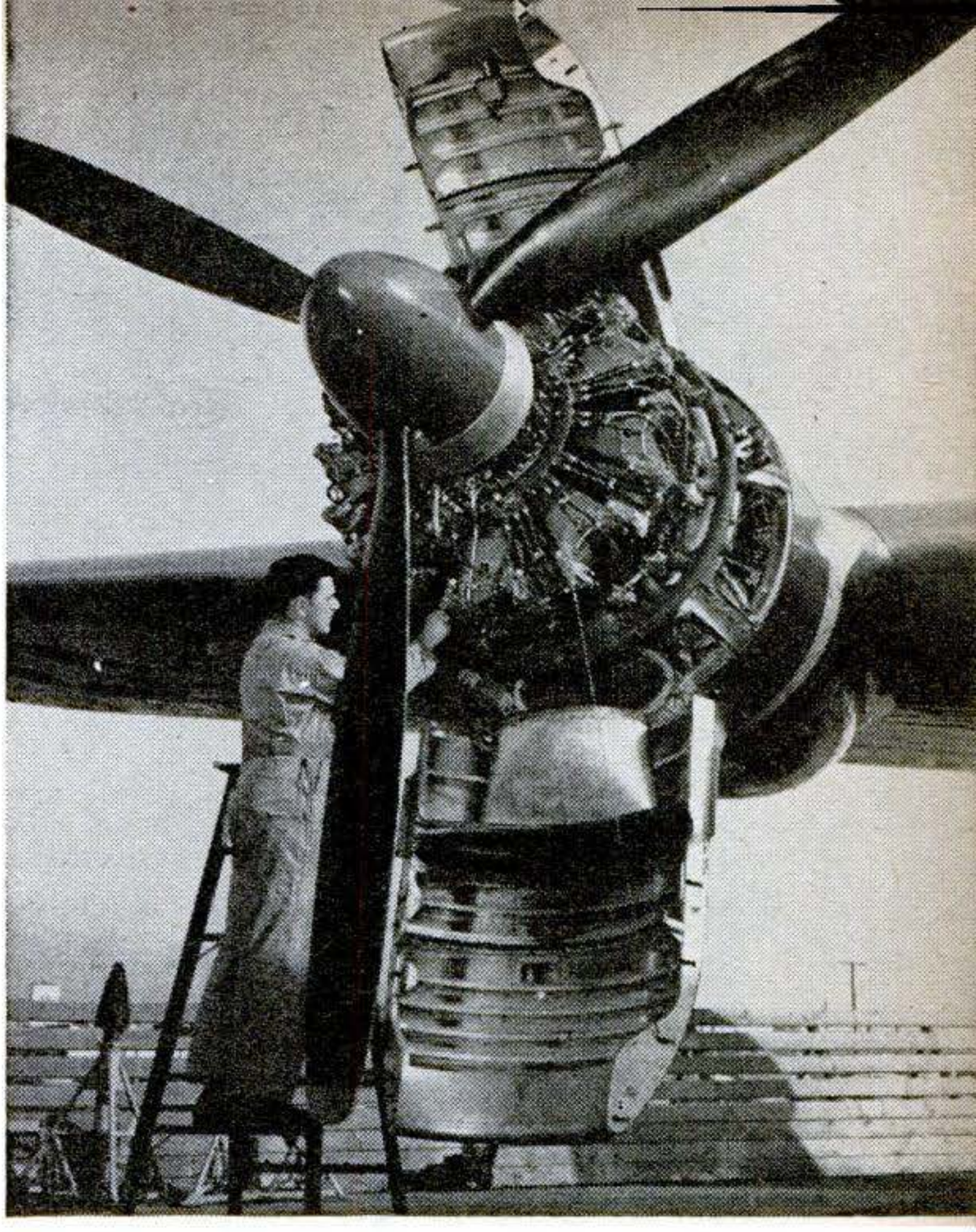
Lightplane Radio Receiver Weighs Only Four Pounds



WEIGHING only 4¾ lbs. and measuring 4½ by 5¼ by 7 inches, the Flyweight Bendix Radio at the right was designed for lightplanes. The unit has a two-band frequency range: 200 to 400 kc. for reception of control towers and civil airway stations, and, when a loop antenna is added, 500 to 1,500 kc. for regular broadcasts.

Lucite "Pipe" Carries Light Around Corners to Compass

A BAR of lucite conducts light from a bulb in the rear of the Sherrill aircraft compass to the card in front. The cutaway head of the instrument (right) shows how the transparent plastic "pipes" the beam around two sharp corners and over three bends.



Constellation's Cowling Can Be Removed in Two Minutes

THE new giant metal jaws that completely enclose each of the Lockheed Constellation's four 2,500-hp. Wright engines can be opened like an automobile hood to give airline mechanics access to the power plants in just two minutes (above). The side panels can be removed quickly without unfastening any hinge bolts or pins. The top panel swings upward and the lower one drops.

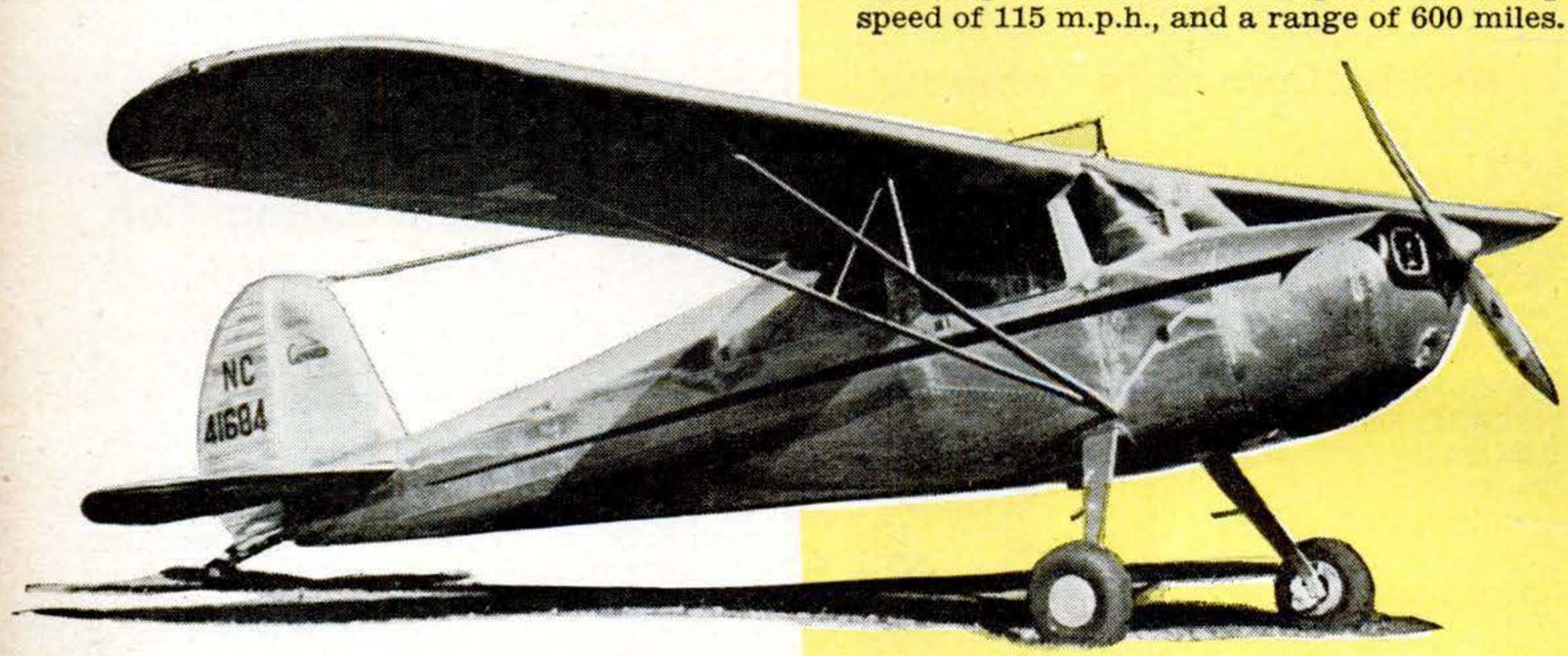
Bottled Medicines Land Safely After Drop from Sky

A PLYWOOD box of pug-nose design (right) can be used to drop plasma flasks and other delicate supplies from low-flying planes without the use of parachutes. The photograph below, taken after tests, shows that none of the glass containers has been smashed. Developed by the Gerrard Co., Inc., of Chicago, and the Air Technical Service Command, the box is first nailed together then strapped by high-tensile steel.

WHAT'S NEW IN AVIATION

Skyranger Has Nonspin Feature

ON THIS page are shown three light-planes that are making strong bids in the postwar market. Above, the Skyranger, of Commonwealth Aviation, Inc., boasts wing slots that make it almost nonspinnable. The ship cruises at 103 m.p.h., has a top speed of 115 m.p.h., and a range of 600 miles.

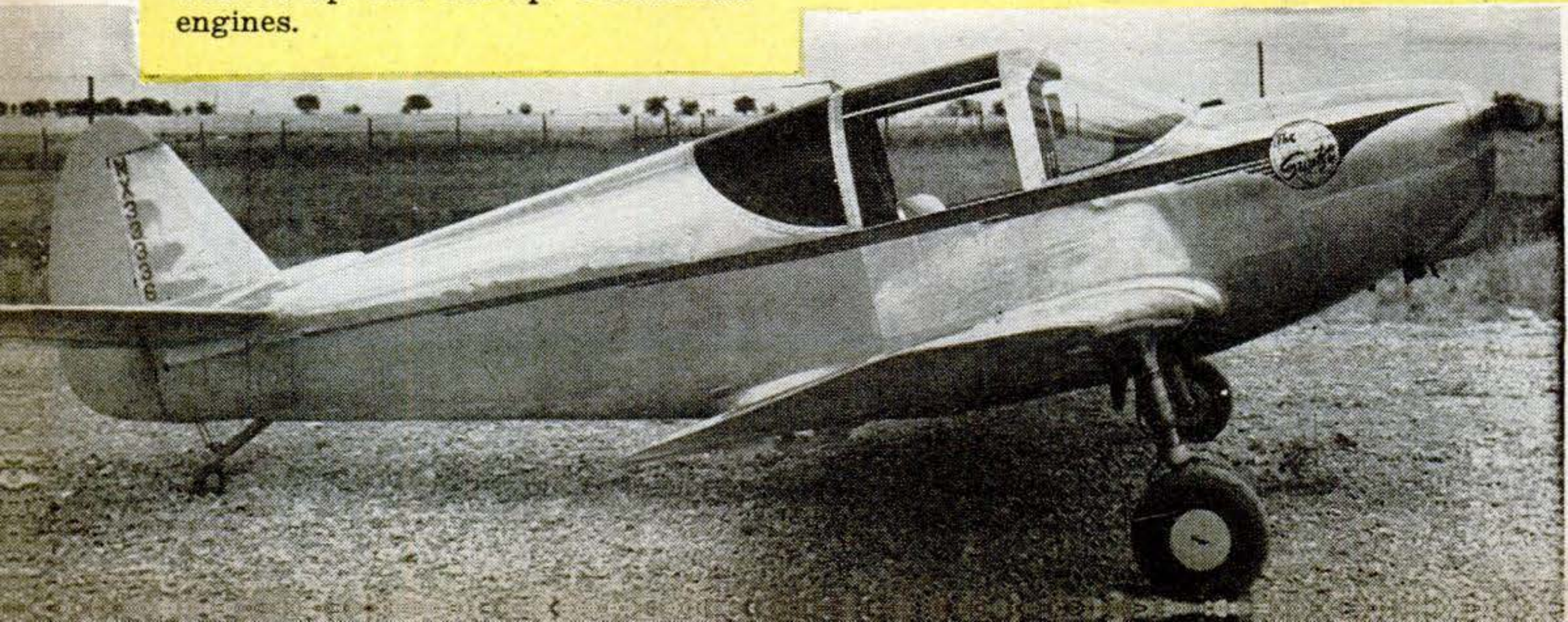


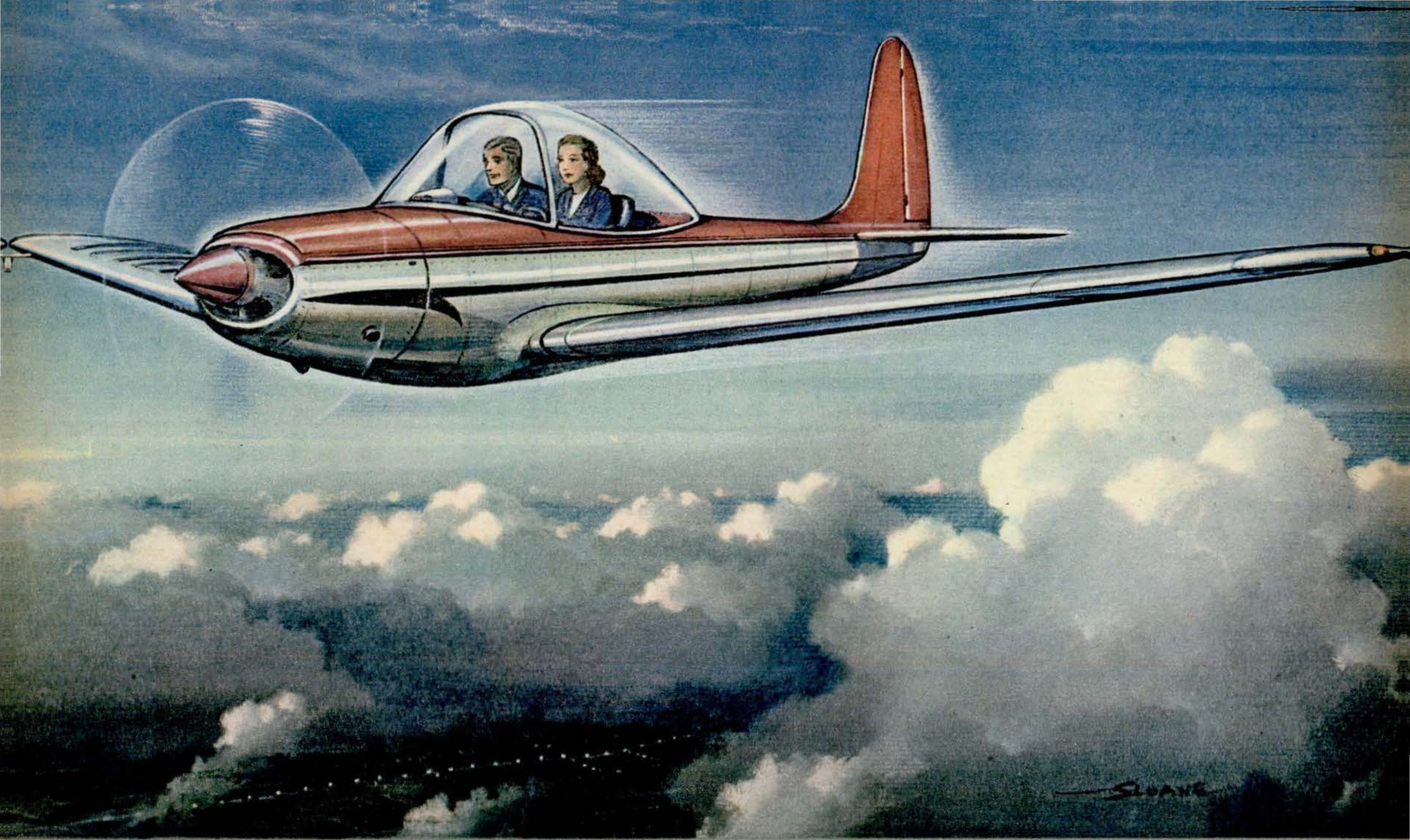
Cessna Stresses Metal Models

THE Cessna "140" (above) and her sister-ship, the "120," are powered by 85-hp. Continental engines, have a top speed above 125 m.p.h. and a range of about 600 miles. Both planes have an all-metal fuselage and control surfaces besides metal-constructed, fabric-covered wings. De luxe appointments distinguish the "140."

Swift Is All-Metal Ship

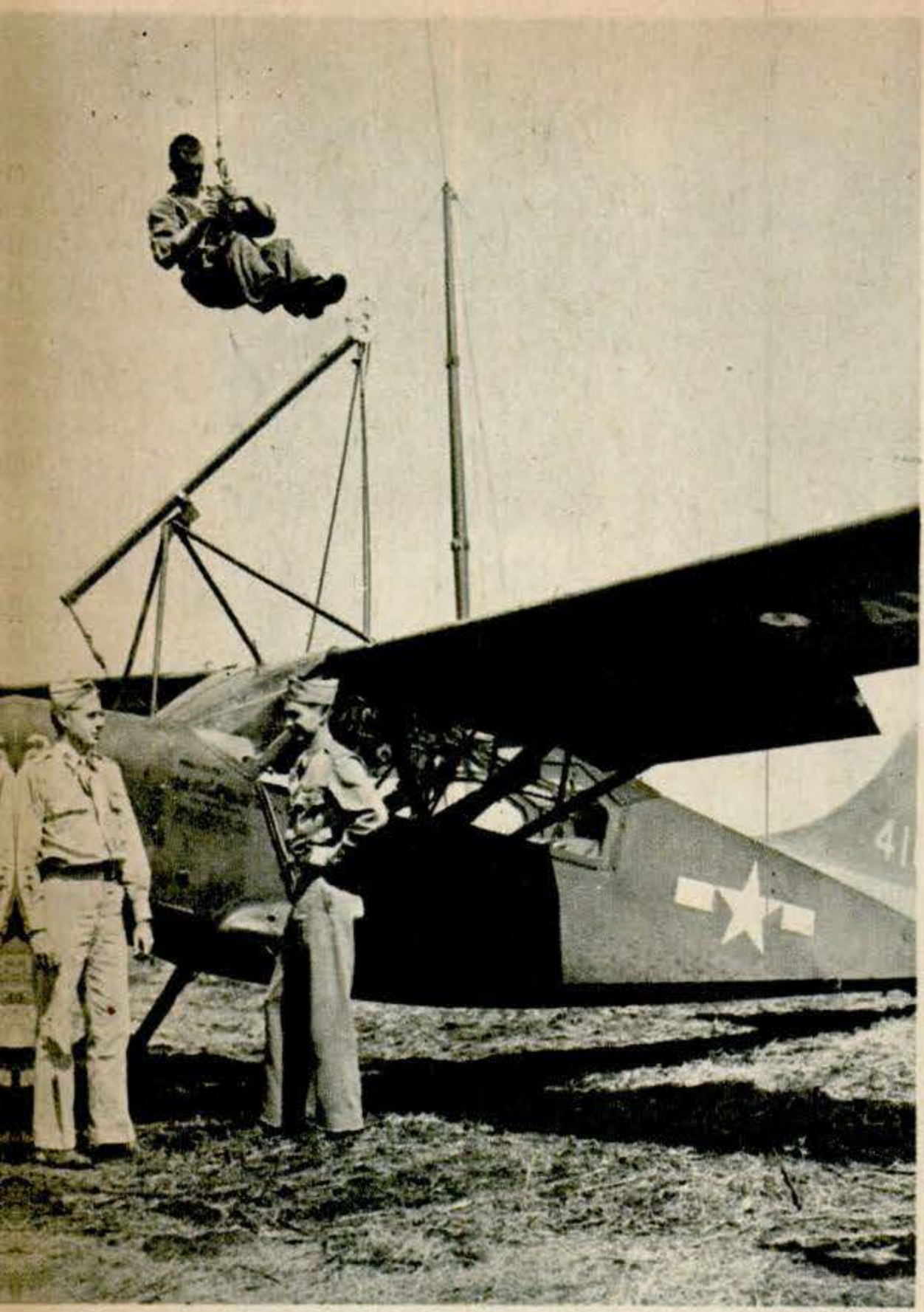
THE all-metal, low-wing Swift (below) has a cabin width of 42 inches that assures plenty of room for two occupants. Cruising speed is 125 m.p.h. and range is 600 miles. It is made by the Globe Aircraft Corp. with 85-hp. and 125-hp. Continental engines.





Your Pin-Up

ALL AMERICAN ENSIGN. This graceful, all-metal, low-wing monoplane is claimed to be the first postwar lightplane of completely new design. Powered by an 85-hp. Continental engine, it has a top speed of over 125 m.p.h. and a cruising speed of 112 m.p.h. Range is 500 miles. The Ensign's wing span is 33 feet and the fuselage length 22 feet. Gross weight is 1,450 pounds, with a useful load of 550 pounds. The cockpit features side by side seating under a full-view canopy.



DESIGNER. Capt. James H. Brodie, inventor of the skyhooks for lightplanes, chats with Ray Gregory, flight officer and test pilot. Plans are already on the drawing board for a Brodie pickup to land much larger ships—possibly as big as C-47s.

Airstrip In the Air

LIGHTPLANES COME HOME TO ROOST ON A CABLE RIGGED ON SHIPS OR IN WILDERNESS

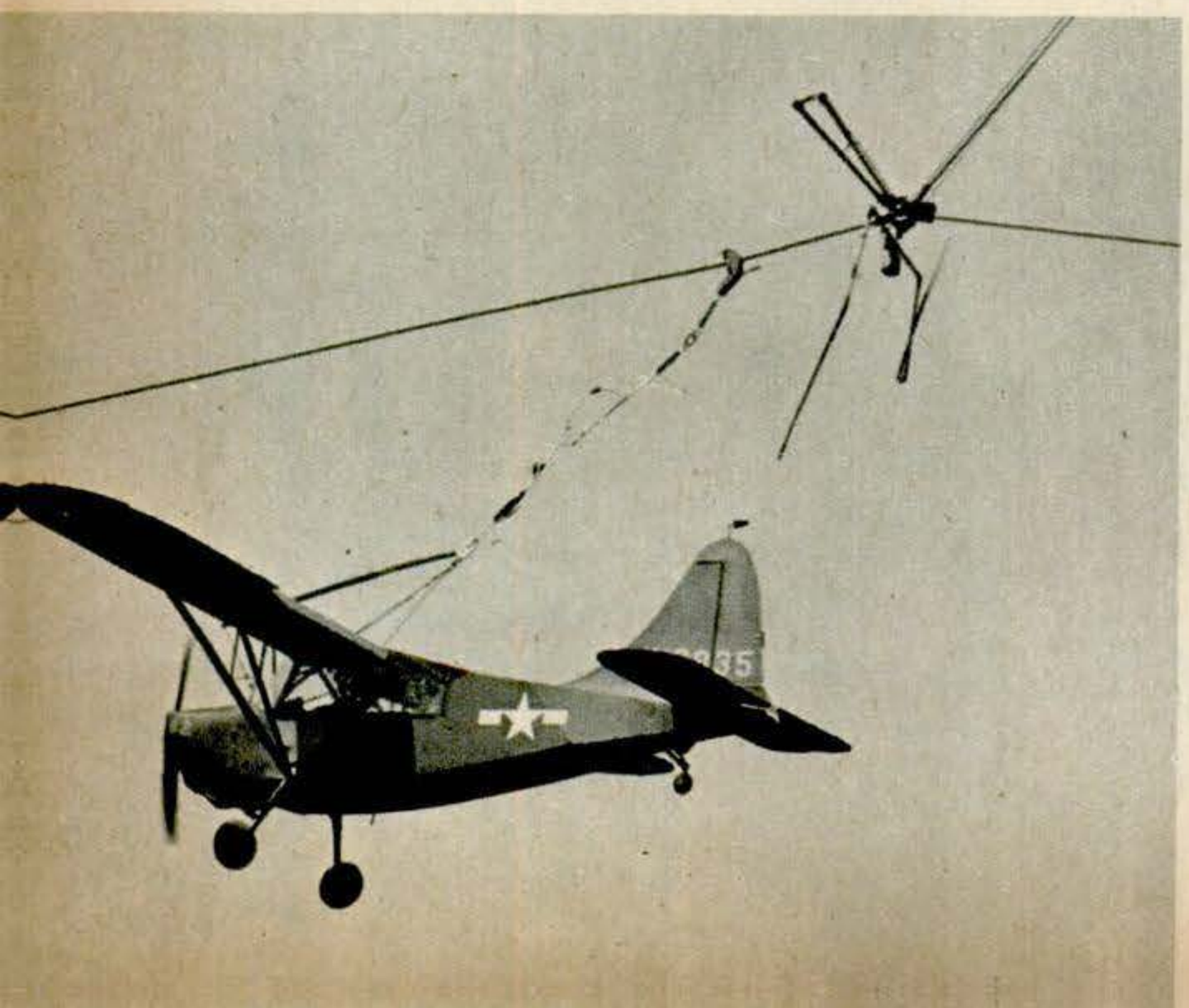
TAKE four masts about twice the height of telephone poles and string a few hundred feet of cable between them, and you have an airport in mid-air on which an airplane can take off and land without touching the ground. Here is a portable airfield that weighs only 6,000 pounds; it can be packed up and carried in another airplane, dropped by parachute, and set up for business by a six-man crew in a couple of hours. With this device and a couple of outboard booms, any ship can serve as an aircraft carrier. The cable rig can be strung across a mountain valley or stream, or installed on the top of a building. It is the most compact airport ever devised.

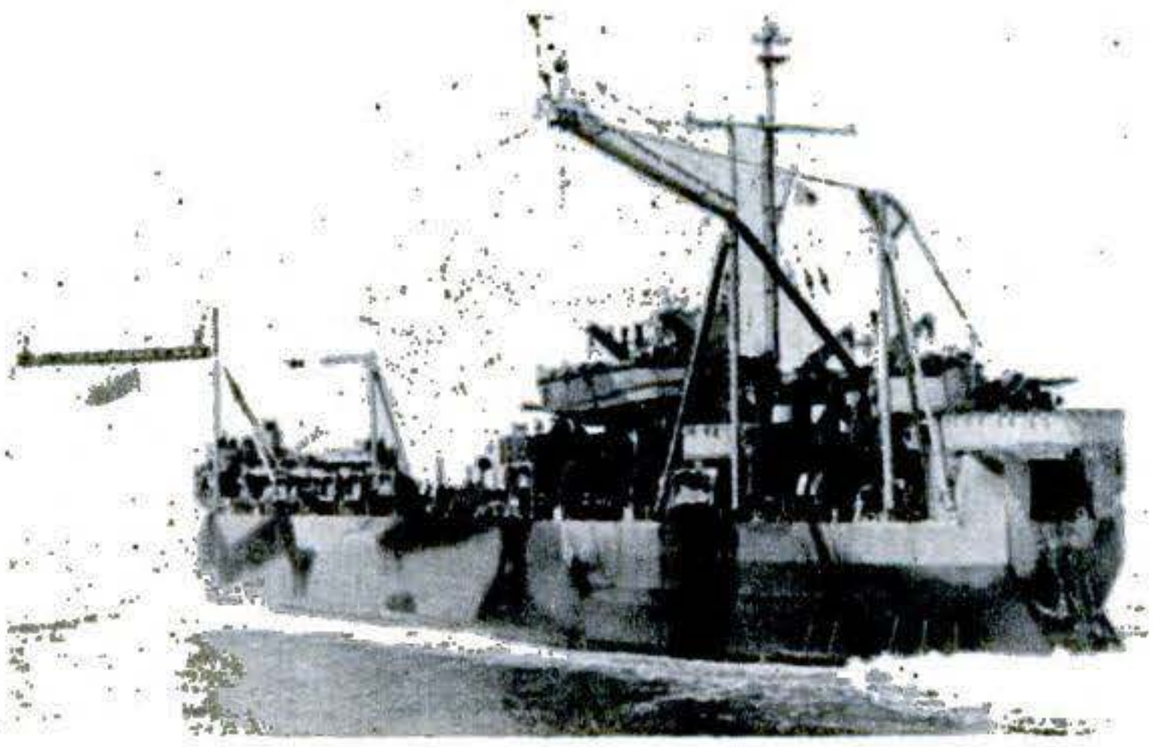
This remarkable skyhook was designed by Capt. James H. Brodie of Wright Field, formerly of the Coast Artillery and Transportation Corps, who flies but holds no AAF pilot rating.

Brodie made the first sketches of his cable rig early in March 1942, but the National Inventors' Council and the Navy—

HOW PLANE MAKES PERFECT LANDING ON WIRE IN THE AIR

A lightplane zips between the cables branching off to the supporting masts and snares a nylon loop hanging from the trolley (left, below). The pilot cuts his throttle and dumps his stick forward to keep the nose down. A brake on the trolley halts the plane. Coasting to the end, plane is lowered by "elevator."





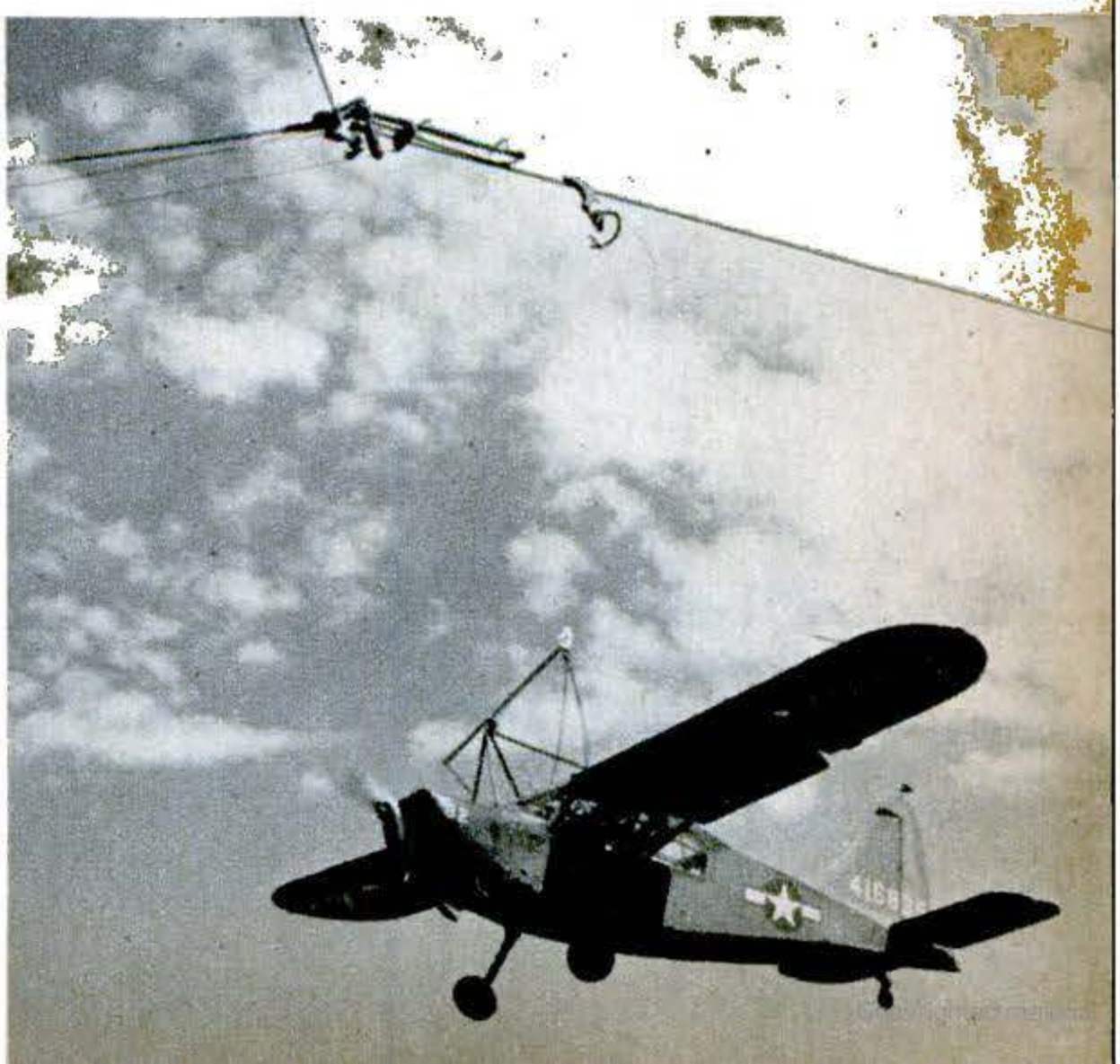
RUNWAYS ANYWHERE. The Brodie Aerial Pickup will make accessible the so-called impassable regions of the world. It may be easily rigged to freighters plowing the Seven Seas, or set up in any isolated wilderness. An outfit weighs about 6,000 pounds and could be dropped by parachute to a ground crew that had trekked into jungle or mountain areas. Construction would take only hours.

to whom the idea was first submitted—refused to believe it. It was through the Army Transportation Corps that Brodie got his chance.

The Brodie System was first tested for the enlightenment of unbelievers at New Orleans in September 1943. This was followed by a sea trial in December, when the Brodie rig was strung between two long booms that overhung the sides of the motor ship *City of Dalhart* cruising in the Gulf of Mexico. Brodie was later assigned to Wright Field and provided facilities to develop further the shoestring airport.

Many postwar uses of the skyhook are contemplated, including ship-to-shore ferrying of passengers, mail, and pilots; airport-post office liaison; installations atop buildings for air commuters and department-store deliveries; setups for forest rangers in mountainous country; and emergency winter operations anywhere when regular airports are snowbound.—JAMES L. H. PECK.

TAKE-OFF. Leaving the Brodie skyhook is as easy as taking off from a concrete runway. The plane is pulled back to the beginning of the cable and is "revved" up while being held securely in place. At the pilot's signal it is released and zooms down the wire to obtain flying speed. Aboard ship, advantages of the wind are gained by ship's maneuvers.



MASS PRODUCTION

For an Ancient Craft

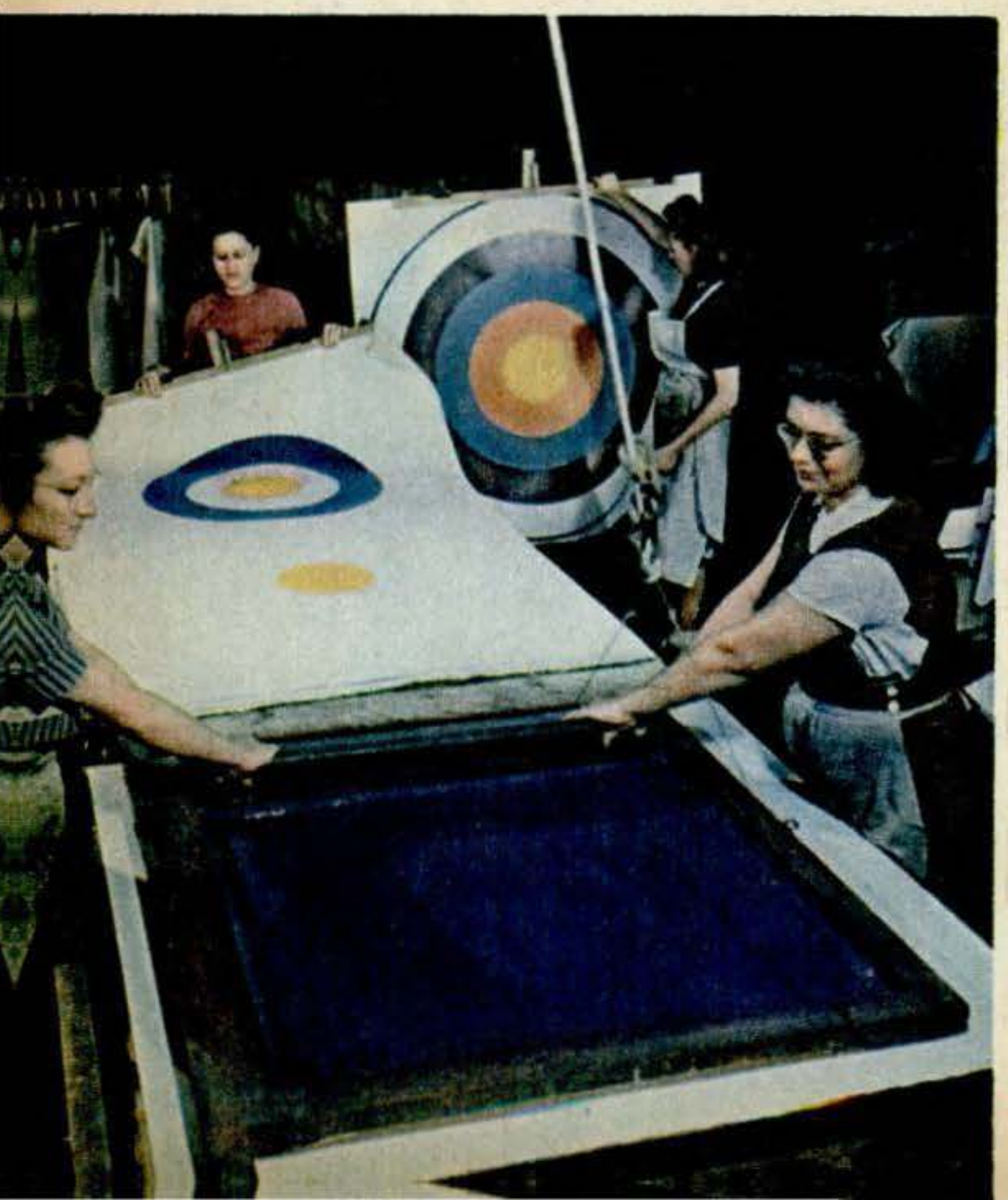
THE bowyers and fletchers who made the weapons for Robin Hood and his Sherwood Forest sharpshooters would be astounded at what has happened to their ancient craft. For hewing the bow from the stave and feathering the arrow to fly true have gone on a mass-production basis to satisfy the modern interest in archery.

The man who has done most to mechanize archery is Ben Pearson, a strapping outdoorsman of Pine Bluff, Ark. A former electrical engineer, Pearson began making bows and arrows 20 years ago to help Boy Scouts win merit badges. Soon he was manufacturing archery equipment for his neighbors. Today, he has a factory employing 600 workers, and from 150,000 to 180,000 arrows, plus equivalent numbers of bows and targets, leave his sprawling plant every night for customers throughout the country.

Pearson's arrows range from the

Ben Pearson, skilled archer and mass producer of bows and arrows, demonstrates a choice Osage orange bow and steel-tipped arrow of Port Orford cedar. Recurved bow, with 55-pound draw, gives added zing.

Mass production of four-foot targets is easy on this printing press. Each ring is applied by wiping color across screen over face of target.



Cheesecloth skirts, sewed on finished target faces, hold the straw backstops. Pearson's targets range from these big banners to folded paper sheets for children.

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TURKEY FEATHERS, wings for the arrows, come to the factory in railroad carload lots. Here they are thoroughly cleaned in enormous vats. After drying, they are sorted, trimmed, and applied to the arrows.

LACQUER BATH. Lacquer is applied to all arrows in this unique dipping machine. It pulls out 100 of them at a time at a rate equaling the drip of lacquer. This process prevents streaks.

TOURNAMENT ARROWS are crested on this device. Both the machine and individual arrows rotate, permitting operator to paint with hairline fineness.

FLETCHING. Each feather is glued separately to the arrows. Glue dries as arrow makes circuit on machine wheel; then another feather is added.

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BOW-TO-BE. For better bows of yew and Osage orange, two three-foot-long billets are spliced together. Both trees grow so crooked in nature, full-length pieces are seldom found.

TRUING UP. Every bow is examined on this contrivance to make certain both limbs have exactly the same degree of bend. Unless the bends are equal, the bow will have an uneven cast, making straight shooting impossible. At left, a workman scrapes down one limb of a handmade yew bow, one of the best. Bow will be shaved until the bends are found to be exactly even.

short ones that children play with to the tough, steel-tipped killers that are used by big-game hunters.

His bows include one-piece hickory snappers for boys and powerful, handmade, spliced, recurved hunting bows.

He buys Port Orford cedar, hickory, lemon wood, yew, Osage orange, birch, straw, and turkey feathers by the carload. Some of this wood is stored for four years to assure complete, natural drying before it is used. Some is kiln-dried to control moisture content and prevent warping.

Machines of his own invention help him prepare the wood, cleanse feathers, crest and fletch the arrows, and splice the bows.

Modern methods, in short, permit him to engage in mass production of equipment that would satisfy Little John.

HAIRCUT. The straw backstop of targets is not ready until it gets a final clipping. A lawn mower, suspended on a spring from ceiling, trims the excess straw to almost putting-green smoothness.

I'D LIKE TO SEE THEM MAKE...

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? Popular Science Monthly will pay five dollars for every such suggestion published

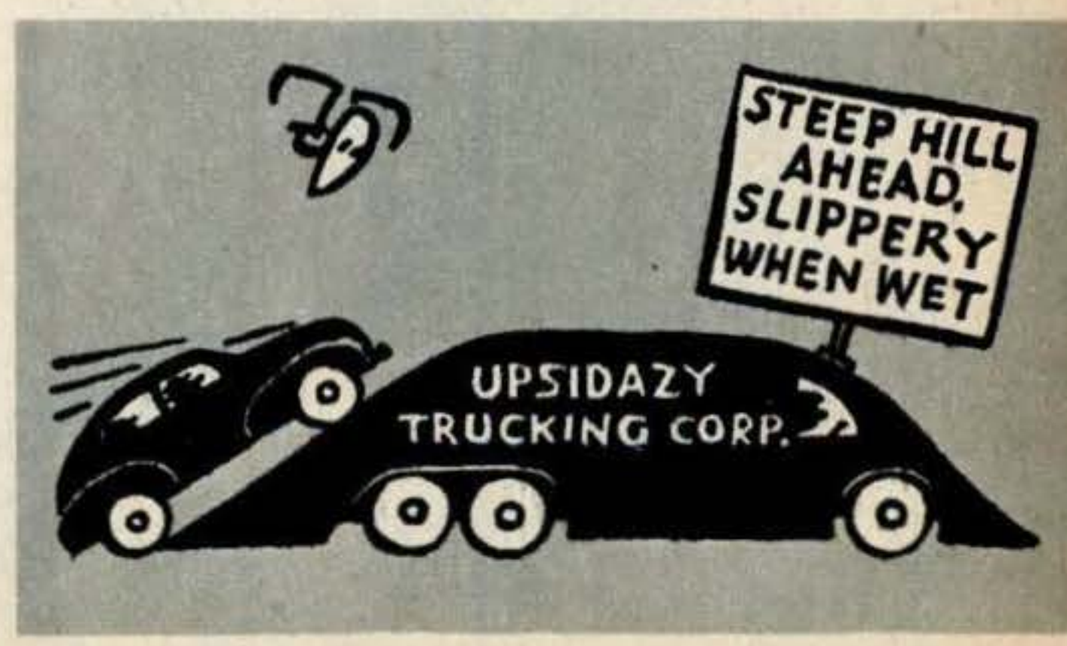
A RAIN-ACTUATED WINDOW CLOSER. With such an invention, there will be no need for you to get out of your warm cot to close the window if a rainstorm starts in the middle of the night. This automatic device is the suggestion of Kenneth Bridgers, Natchitoches, La.

SELF-LIGHTING CIGARETTE. A boon to friends of the gimme-a-match smoker. The tip is coated with a material that will ignite by air friction when the smoker pulls his first drag. This labor-, time-, and match-saving idea comes from J. A. Talipski, Pittsburgh, Pa.

AUTOMATIC SECRETARY that will take dictation, repeat it back, and also type it. Idea comes from Abraham S. Friedman, of Brooklyn, N. Y. Dr. Vannevar Bush, atom expert, has predicted this sort of machine.

BLINKER LIGHTS for subway stations to warn waiting passengers of approaching trains. They would prevent accidents to people leaning over edge of platform. Harry Morris, New Yorker, saw the need for this.

OVERPASS TRUCK. It wouldn't slow up passenger cars on a narrow road. The body could be constructed turtle-back fashion with an easy slope to the ground, both rear and front. This construction would make it possible for the following motorist, anxious to catch a time clock, to drive his car right over the top of the heavy, lumbering truck. Wheel guides on the truck top would keep the overtaking car on the beam. Herman D. Post, New York, sends this idea for greasing the wheels of progress.



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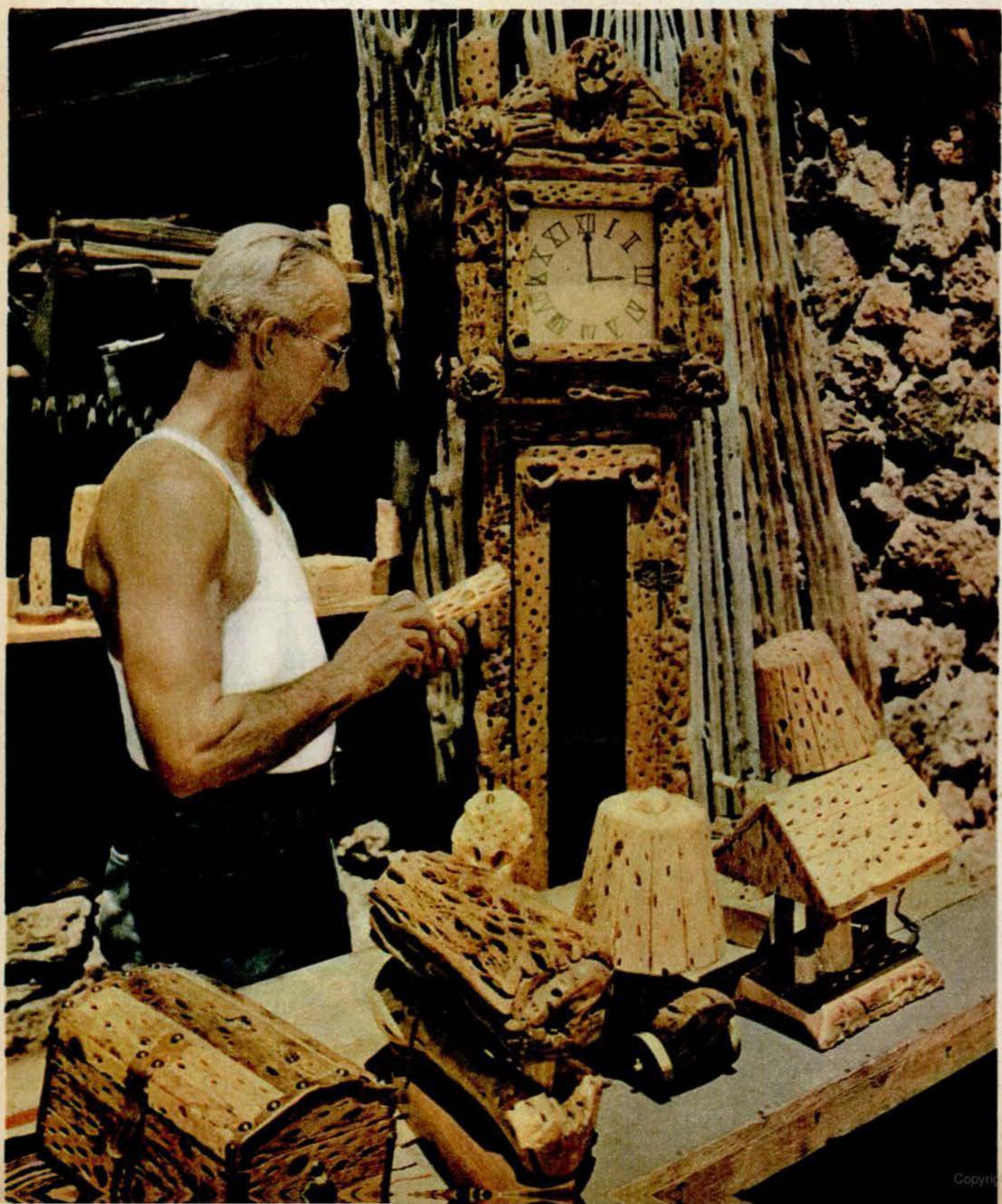
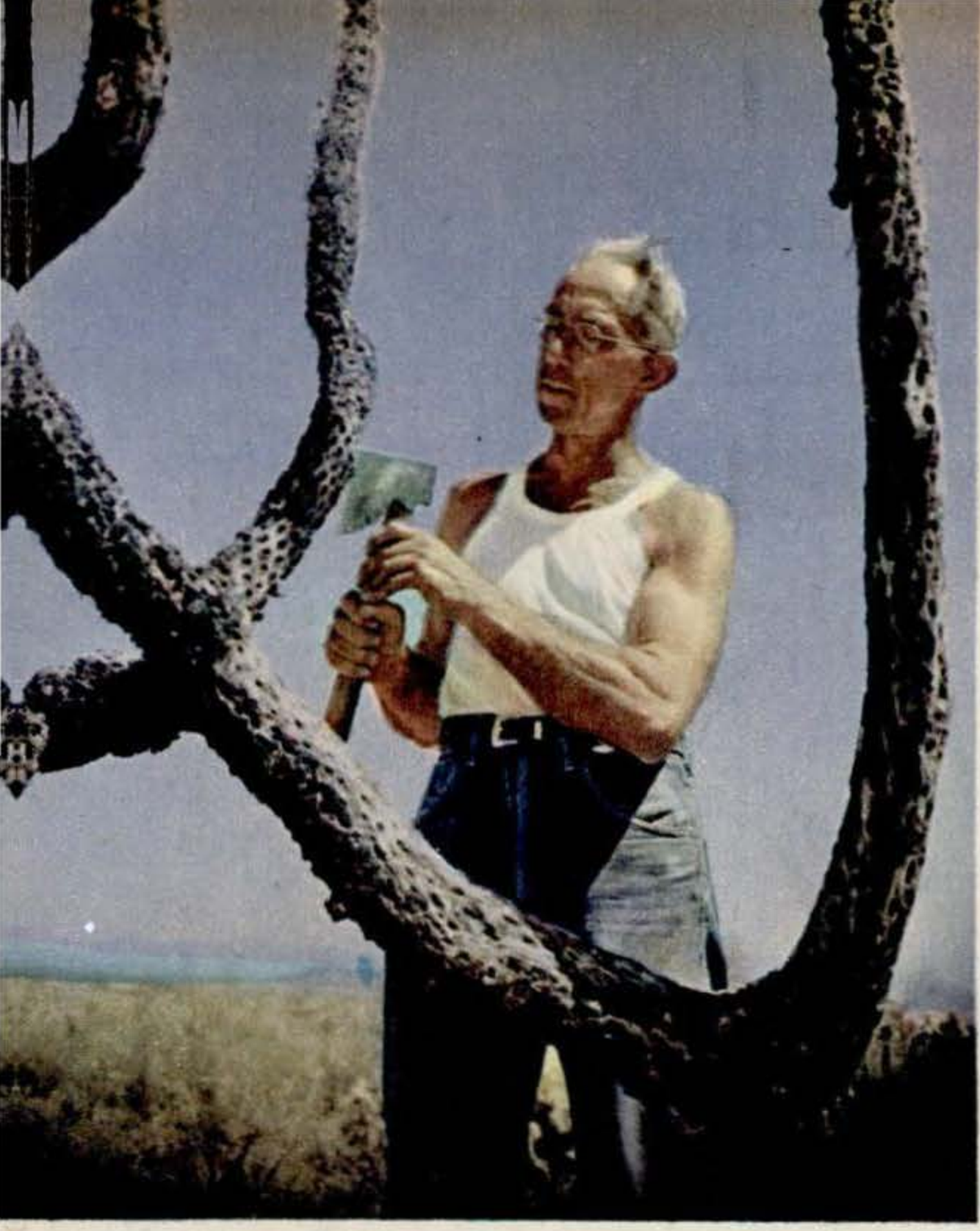
CACTUS CRAFTWORK

Spiny desert vegetation of certain varieties proves good material for furniture making.

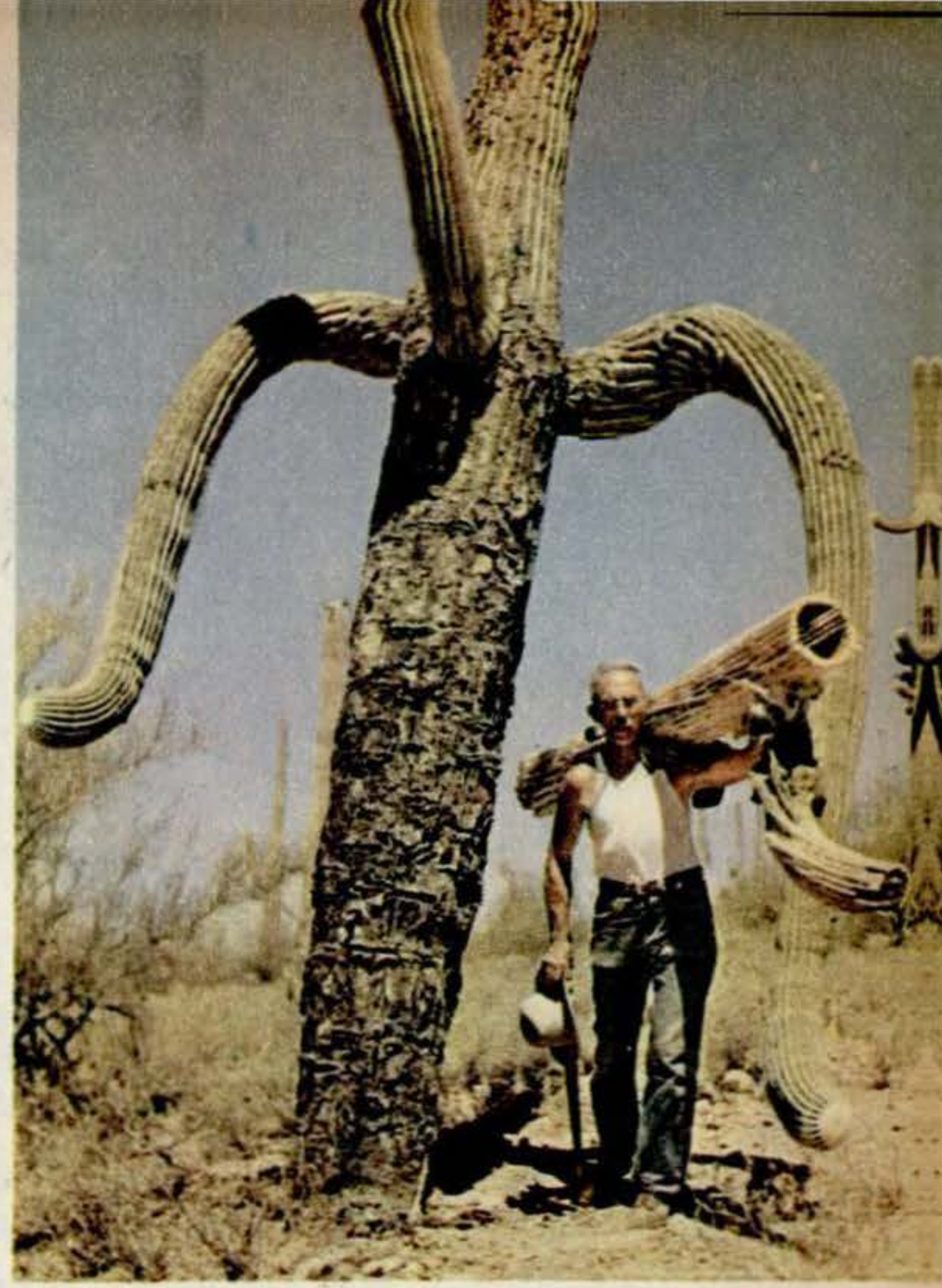
FURNITURE from cactus trunks sounds like a wild (and uncomfortable) dream. But Herb Wood, desert dweller down near Tucson, Ariz., is making tables, chairs, and even grandfather clocks out of the dead trunks of the useless-looking saguaro and cholla cacti. Wood started out 15 years ago with a rusty saw, a hammer, and some sandpaper. Today he has a completely fitted workshop in which he turns out cactus furniture for customers in all parts of the country. To insure better matching of the pieces, he has invented a special glue, of which cactus-wood dust is the base.

Herb Wood, cactus craftsman, holds a candlestick that he has made of cholla. Around him are other vivid examples of his handiwork—lamps, jewel boxes, and a made-to-order grandfather clock for a British buyer.





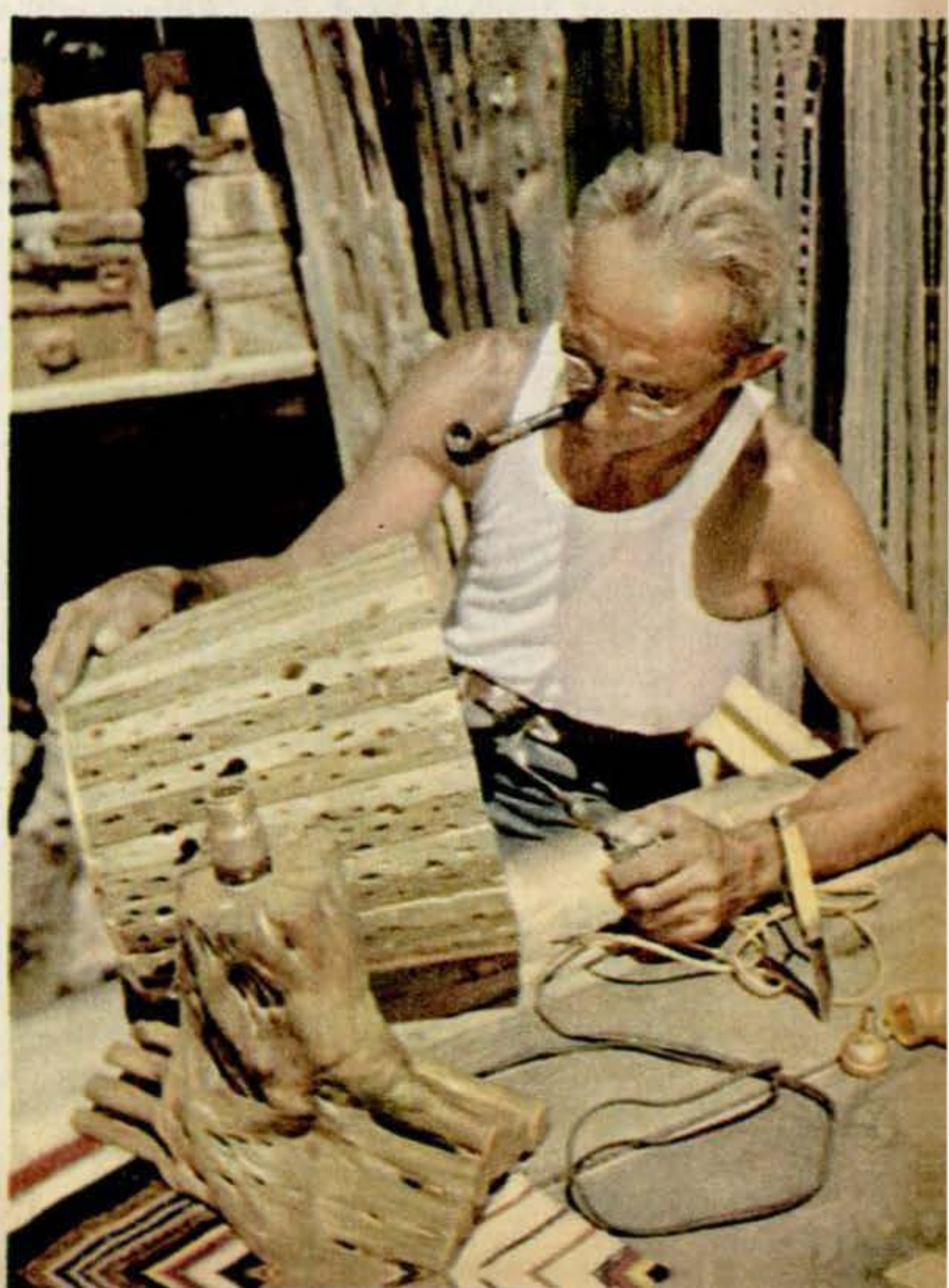
Desert cabinetmaker goes after a dead cholla with a keen hand ax. He never destroys a living plant in collecting material for his furniture. The seasoning, therefore, is well begun at the time of cutting on the desert.



Fairly large sections of a saguaro cactus are light enough to be carried shoulderwise to the workshop. Extra distances and heavier-than-ordinary loads are negotiated with the help of desert-trained burros.

Cactus wood has to be thoroughly cleaned before it can be used for cabinet work. Here it is being scrubbed vigorously to remove every trace of the sand and dirt that desert wind and rain have embedded in its surface.

The ribs of the saguaro that Wood is toting home in the above picture have been fashioned into a table lamp. When the simple wiring, shown under way, is completed, the lamp is practically ready for sale.



ADMIRAL

When the movie-makers call for speedboats, kayaks, dugouts, or longboats, Skipper Benton Roberts can deliver the boats.

By
ANDREW R. BOONE

A "task force" of English longboats, supplied by Benton Roberts, pulls up alongside a set representing an ancient British sailing ship. Roberts often supplies hundreds of marine props for a single production, all accurate copies from particular periods.

Skipper Roberts takes to the oars (right) to test a longboat on his private lake before shipping it off to a movie studio. Boats and trappings from his shop have appeared in more than 1,300 motion pictures.

SKIPPER of the world's largest private fleet is Benton Roberts, whose boats roam the seven seas yet seldom leave the landlocked waters of a few California lakes. Robert is master of 100 ships, a fleet he has been building for 14 years. When a Hollywood studio wants a kayak or a yacht, Roberts can send one around. He can also supply an authentic Barbadoes dugout, birchbark canoes, English and French longboats, sailing yachts, and magnificent mahógany speedboats. He accepts the most improbable demands from movie-makers without batting an eye, and can create, almost overnight, any small craft required for a picture. In addition, his shops alongside tiny Lake Machado, near Wilmington, Calif., are crammed with tens of thousands of such working props as compass binnacles, belaying pins, figureheads, Japanese steering wheels, and iron capstans. This master of craftsmanship, a former studio carpenter, has supplied boats and their trappings for more than 1,300 pictures.

Roberts is constantly on the lookout for types of boats he doesn't possess. Not long ago he found an old-fashioned, 50-passenger wooden lifeboat aboard a coastal tramp steamer. He loaded it on his trailer, and wheeled it 450 miles down the California

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OF HOLLYWOOD'S NAVY

coast to his shops. Here he calked the seams, lowered the boat into the water, and promptly rented it for two months at $50 a week. That's the way he handles all his props. He sells nothing. Charges range from 25 cents a week for a life preserver to $45 a day for a speedboat. An 800-pound tug fender rents for $50 a week.

Before the war, Roberts usually delivered his boats to selected spots along the seacoast. But during the war Army and Navy censorship clamped down on real coastal scenes, and the movie-makers began filming deep-sea and port settings on their own lots—in tank lakes. It was to the tank lake on the Metro-Goldwyn-Mayer lot that Roberts delivered 34 boats, from dories to fishing schooners, for "Mrs. Miniver." The craft "acted" for one day only, and Roberts supplied them during a single 24-hour period.

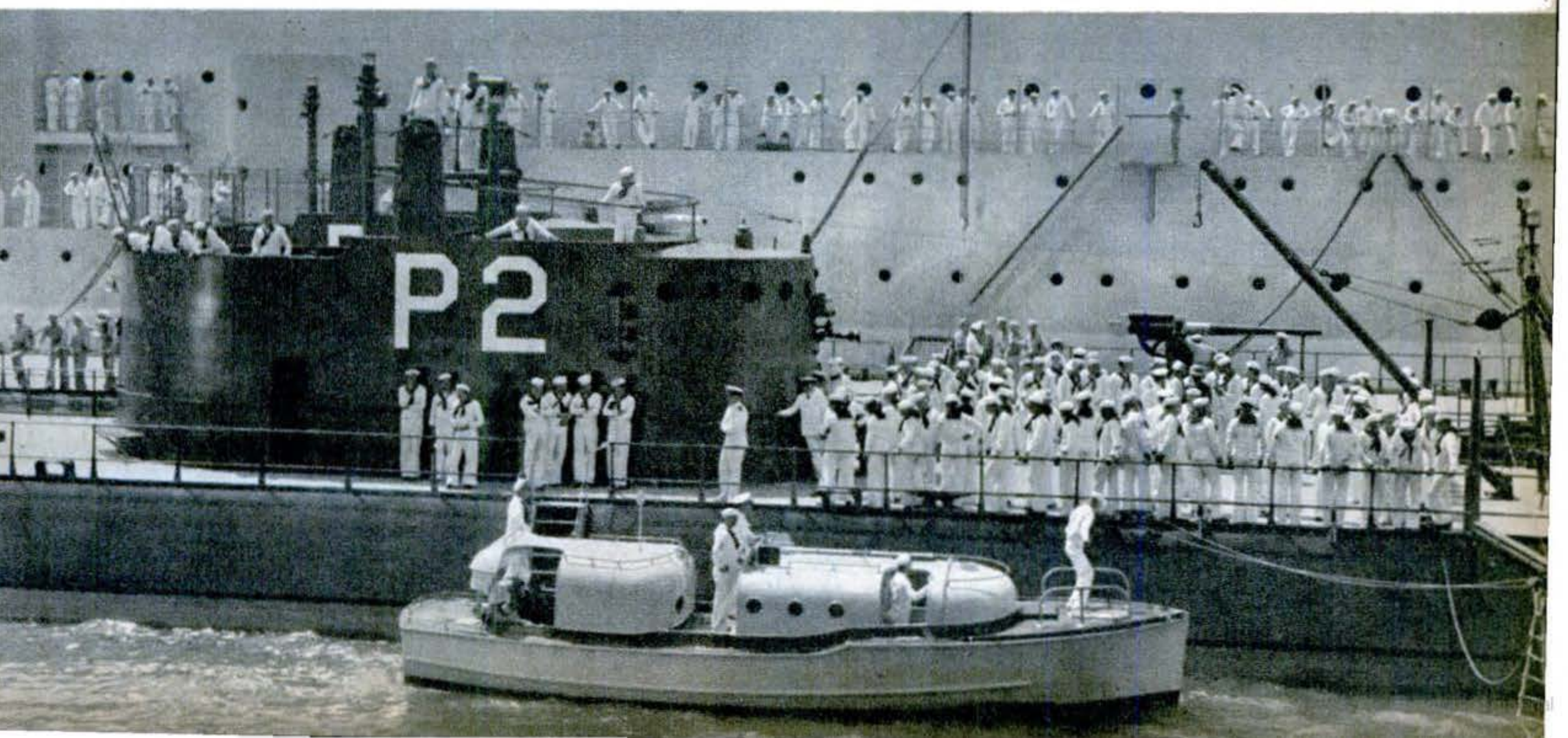
The Hollywood skipper not only converts types, but makes them do tricks when necessary. In one picture, Leo Carrillo was considering the purchase of a speedster from Frank Morgan. "If the motor she go, I buy heem," read Carrillo's line. The director wanted the boat to start, then capsize immediately, but the propeller had to be shown churning. Roberts rigged an air motor and tripped one valve to cause the boat to overturn and then another to keep the propeller spinning. He earned $250 for his ingenuity.

Roberts is constantly studying pictures—stills from newsreels, books, and magazines. He keeps no inventory of his many items, but relies on an encyclopedic memory. "It's all between my ears," he declares. "That sampan should be around here somewhere."

For this period picture, the master marine craftsman, was called upon to provide a canoe as strictly authentic as the costumes that the actors wore.

Roberts rebuilt this Italian gondola, from keel to baldachin (canopy), for a Warner Bros. picture. His fleet also has dugouts, kayaks, and speedboats.

A captain's gig (superstructure by Roberts) ties up alongside prop subs against a battleship background.



Industry Works Wonders

Auto doors assembled in nine seconds, other jobs done with dazzling speed and at reduced cost by "resistance" welding

By TOM MAHONEY

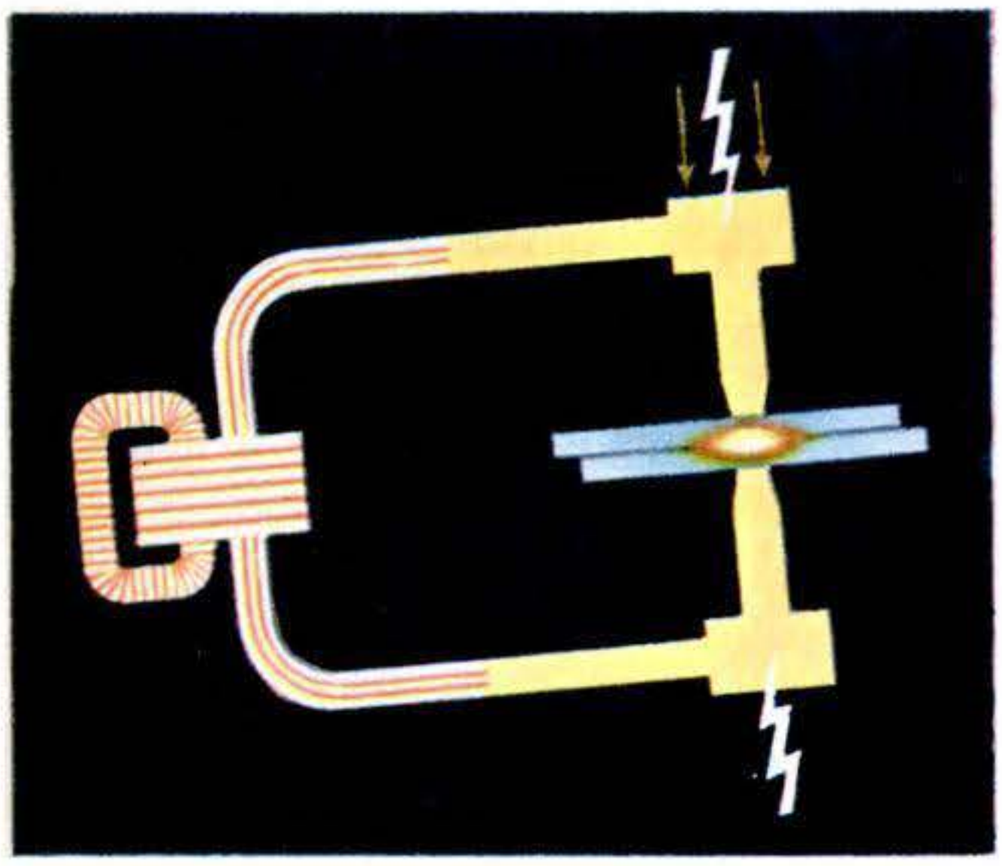
HALF a dozen assorted pieces of steel arrive by conveyor at a special machine in an automobile body plant. A worker lays the pieces into a fixture, presses a button, and 56 copper-alloy fingers press automatically into the work. For a fraction of a second a heavy charge of electricity shoots through each. The jaws of the machine open with a slight clang and hiss, and the work is lifted out. The pieces of steel are now an automobile door, assembled in nine seconds by the magic of resistance welding.

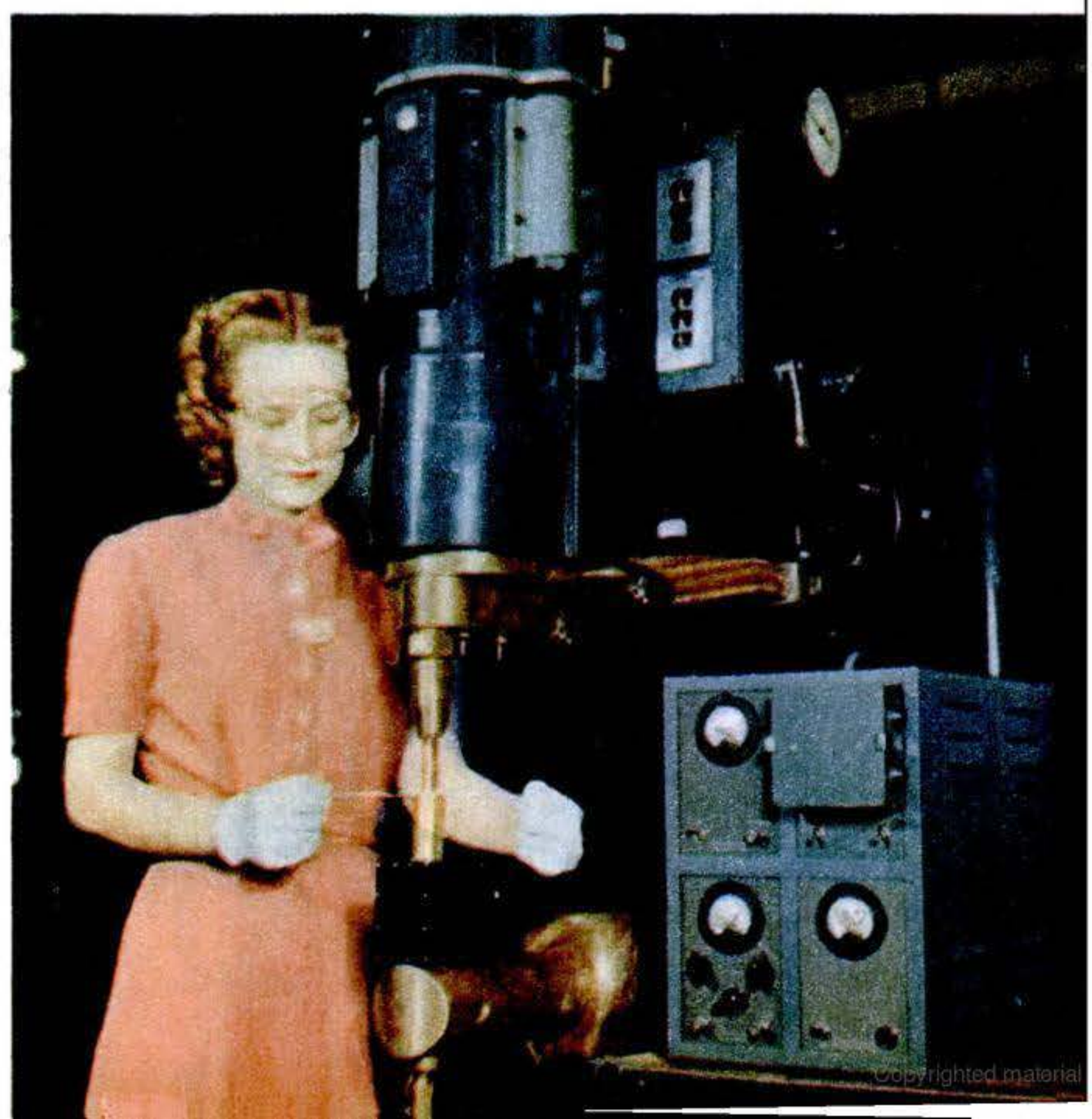
Resistance welding is the fast, modern, scientific counterpart of man's oldest method of joining metals, hammering red-hot pieces together at a forge. Resistance to electricity at the surfaces to be joined supplies the heat and gives this form of welding its name. Manual or mechanical pressure takes the place of hammering. The process was improved greatly during the war and is now speeding production and cutting costs in many civilian industries.

Resistance welding requires no extra metal, and the joining takes place when the metal is plastic but not molten, at lower temperatures than in arc welding. Resistance welding is ideal for joining chromium-nickel stainless steels, for heat is applied only briefly and its adverse effects on metal minimized. Electronic tubes do most of the timing. Once controls have been adjusted for the work being handled, most resistance-welding machines could be run by girls in bobby socks.

The simplest and most popular form of resistance welding is *spot* welding. The weld is made in a spot about a quarter-inch in diameter by clamping the flat surfaces between two electrodes and passing a heavy current through them. In machines such as those that fabricate automobile doors, many spot welds are made simultaneously. The work is usually brought to the machine but there are welding guns that can be moved around large assemblies. A variation of spot welding is *projection* welding, in which one of the surfaces has projections that are welded to the other.

Where a pressure-tight joint is required, spot welds can be made to overlap by passing the current through wheel-shaped electrodes and the process becomes *seam* welding. Thousands of droppable fuel tanks for airplanes and five-gallon, all-purpose "blitz" cans were seam-welded during the war. The process is now important in the manu-





SPOT WELDING

Operator makes sample weld of two pieces of aluminum with a resistance-welding machine that uses the principle shown in the drawing. Dialed instrument tests machine's efficiency.

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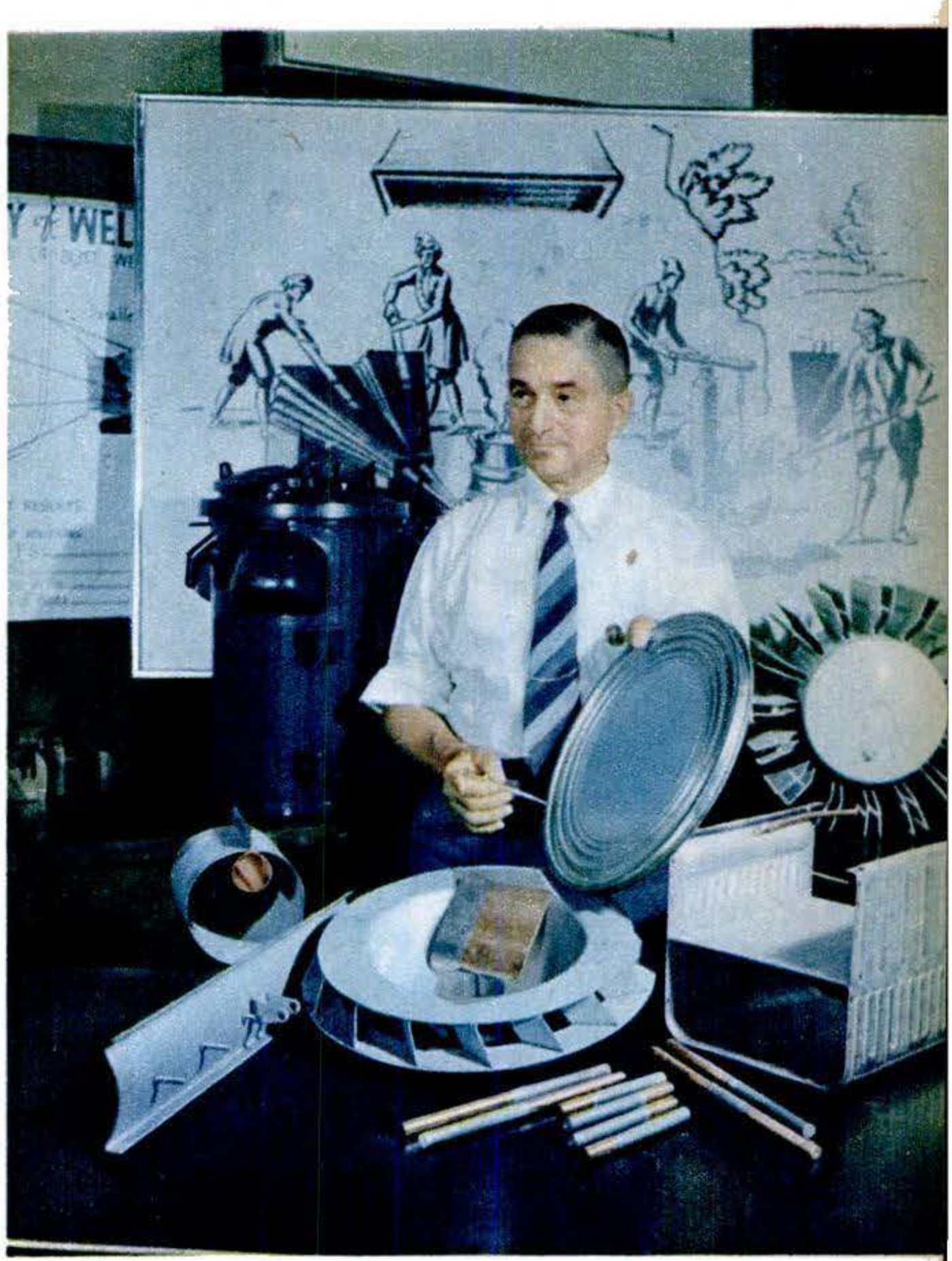
By Welding

facture of refrigerators, tubing, containers, and similar products.

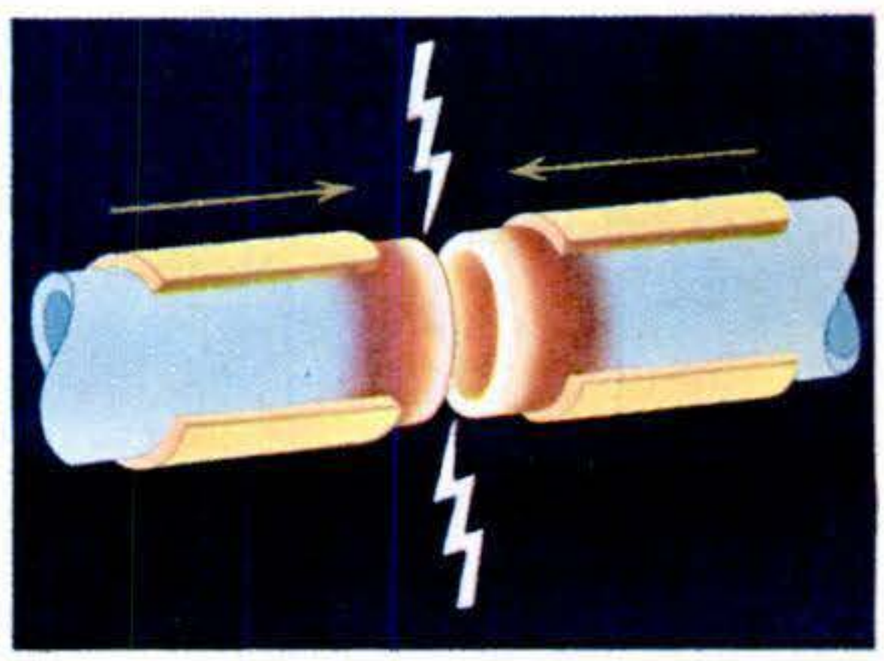
Most spectacular form of resistance welding is *flash* welding, marked by showers of sparks. The pieces are clamped in electrodes, raised to the melting point by an arc between them, and then squeezed together. The melted surface is forced out and the adjacent plastic zones are forced together in a high-quality, forged weld. A similar variation is *upset butt* welding, in which the butt edges are forced together *before* the current is applied. Large chains, links, motor frames, and similar products may be flash welded.

A small spot welder may be bought for $75, while a giant flash welder that joins strips for pickling in a steel mill costs more than $250,000. Yet, impressive savings over other types of welding, as well as other methods of fabrication, are usual with resistance welding when the design is proper and mass production is required.

At Northrop Aircraft, riveting costs about two cents a rivet and spot welding less than one half cent per spot. Spot welding effected a saving of $149 per unit in fabricating the tail boom of the P-61. Use of



Nearly every kind of resistance welding was used in making these products. For instance, the stainless steel diaphragm that R. T. Gillette, of General Electric, is holding required both flash and seam welding to construct. Flash, seam, spot, and projection welding put together the distribution transformer tank at Mr. Gillette's right.



FLASH WELDING

A fireworks display of incandescent metal is set off as a technician demonstrates flash butt welding. Two pieces of steel, brass, aluminum, nickel, or almost any other engineering metal are welded edge-on, as the drawing illustrates. The process takes from one to 20 seconds, depending upon the size of the pieces being welded.

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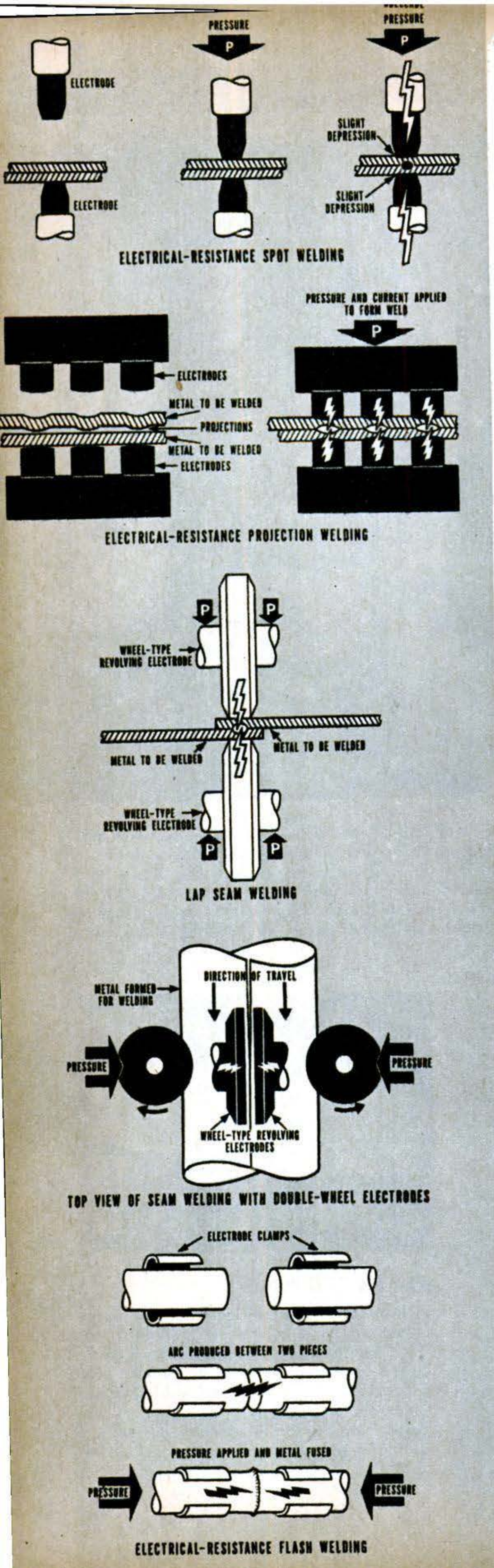

resistance welding in filling the International Harvester war contract for armored half-tracks saved $240,000, it was estimated, in operator-training expense alone. Spot welding saved $225 per car in the fabrication of railroad boxcars. Seam welding does for one fifth of a cent the welding on a grease gun that formerly cost two cents by arc welding. A flash welder paid for itself in three months with savings in the cost of assembling "banjo" housings for rear axles of automobiles.

Phenomenal production rates are possible with the process. Tack welding a steel drawer formerly took three persons 30 minutes; with resistance welding, two persons do it in two minutes. Auto and truck wheel rims are welded five to 10 per minute. A special press-type welder produces a triple weld in metal radio tubes, joining the socket, filament assembly, and casing in a single operation. Production is 2,500 per hour. A multispot fixture makes 4,000 spot welds to assemble 1,000 separate stampings into 100 automobile radiator grille halves every hour!

From 1886, when Dr. Elihu Thomson accidentally discovered the power of electricity to fuse metals, until World War II, all resistance-welding machines in commercial use in the United States were powered by alternating current stepped up to high amperage by a conventional transformer. This was satisfactory as long as most of the metal handled was steel and most of the work was being done in industrial centers that had ample electric power.

The war changed this picture. To meet airplane quotas, large-scale spot welding of aluminum was imperative, yet, because of its lower resistance, a spot weld in aluminum requires three to five times the current needed for the same weld in steel. The war also created a need for resistance welding in areas where an alternating-current machine would disturb the power supply so badly that lamps would flicker and clocks stop.

"Stored-energy" machines were the answer. The first of these was brought to the United States in 1939 by Mario Sciaky, a French engineer. Sciaky and his four brothers had developed a direct-current, spot-welding machine with a power peak

FEATS OF HEAT AND PRESSURE

These drawings, reproduced by courtesy of the Allegheny Ludlum Steel Corporation, clearly show the principal ways in which heat, generated in a matter of seconds by metal resisting the passage of heavy currents of electricity through it, and great pressure are used to make resistance welds.

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only one-tenth as high as that of the alternating type. With ignition tubes, it converted alternating current to direct current, stored this electromagnetically in a transformer, and, when the charge became sufficient, discharged it into the weld.

The Navy's Bureau of Aeronautics bought the first Sciaky machine. Forty more, imported from France, went to American airplane manufacturers before France fell. Production of the machines then began in Chicago.

The older U. S. machine makers speedily matched the Sciaky device with a machine in which direct current was stored in banks of condensers. A third solution was introduced in 1944: a stored-energy machine in which the current is stored at low voltage in storage batteries. This frees resistance welding from dependence on power lines. The whole equipment, including battery charger, is available on a rolling cart.

Originally applied only to spot welding, stored-energy systems are now being adapted to seam welding. One large seam welder of this type has high-condenser capacity with suitable charging and sequence-control arrangements for making either intermittent or continuous welds.

Stored energy was probably the greatest single factor in increasing the number of spot-welding machines in the aircraft industry from about 20 in 1939 to 6,000 at the end of the war, and placing some spot- and seam-welding in every war plant. Other developments helped, however. One was the adoption of standards for techniques and quality of spot welds. Another was the proper cleaning of material to be welded.

When exposed to the air, aluminum quickly develops an oxide coating that makes it necessary to clean electrodes frequently and makes welding unreliable. Various methods were proposed for eliminating the coating. But Dr. Wendell Hess, at the famous welding-research laboratory of Rensselaer Polytechnic Institute at Troy, N. Y., worked out a way to tell how effective the cleaners were by measuring the surface contact resistance of the metal.

This has resulted in valuable, low-cost, aluminum-cleaning solutions. Northrop Aircraft and the Kelite Co., for example, have developed an etch solution with a phosphoric-acid base that has made possible runs of 12,000 welds at Northrop without electrode cleaning. A run of more than 300 welds without cleaning was considered remarkable as late as 1943.

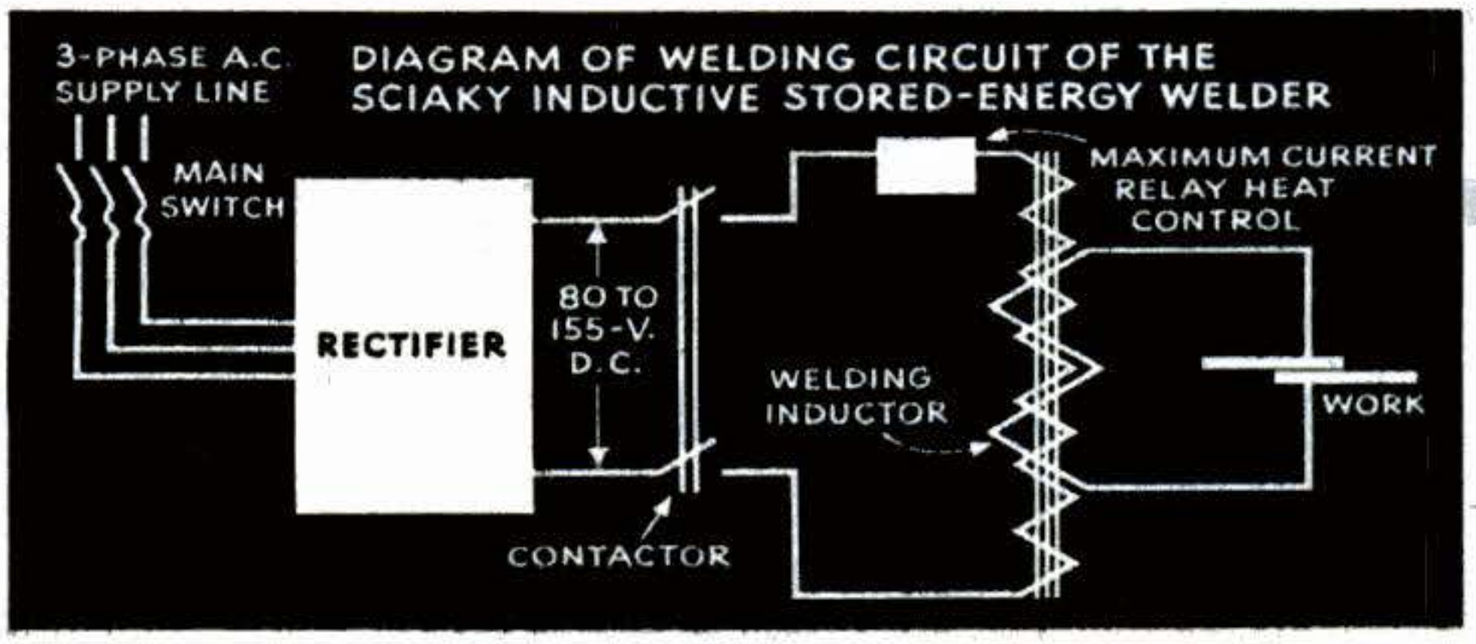
A process for spot-welding light gages of armor plate and other hardenable steels was an important war development worked out by Dr. Hess and his R.P.I. associates with engineers of the Progressive Welder Co. of Detroit. This process does for the weld in a matter of seconds everything that the old-fashioned blacksmith could do for metal. While the physical pressure is varied, the weld goes through the stages of preheat, welding, cooling, grain-refining heat, cooling, and finally a tempering heat. The result is a truly forged weld, and the sequence can be varied for almost any steel.

Resistance-welding electrodes, which may be required to deliver pressures of as much as 30,000 pounds and to carry currents of 75,000 amperes per square inch, have been improved. Copper alloys of good conductivity and higher strength are available. During the war, tungsten carbide electrodes were developed for the electroforging of machine-gun parts.

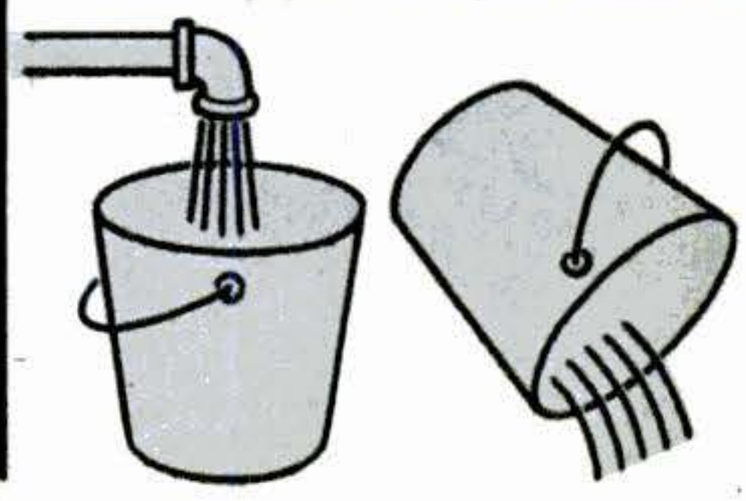
Many dissimilar metals are being joined by resistance welding. R. T. Gillette, of General Electric, has patented a process for the resistance butt-welding of copper to aluminum that is used in fabricating electrical equipment. Lead is being spot-welded to steel to provide protective linings for X-ray equipment. During the war, millions of aircraft spark-plug electrodes were produced by welding a tungsten tip to a nickel spindle. Aluminum can be spot-welded, with fair results, to magnesium alloys, zinc, tin plate, phosphor bronze, and brass.

Some of its practitioners boast that it is now possible to join any metal, similar or dissimilar, by resistance welding.

HOW "STORED ENERGY" WELDING MACHINE WORKS



It stores current, as a bucket slowly fills with water from a small pipe, for quick release.



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BIRTH OF CLOUDS. Moving light behind this three-dimensional model gives the illusion of warm, moist air rising to a height where it cools, forming cumulus clouds. The effect of air currents on airplane flight is depicted by model planes; the dotted lines show courses planes follow under certain conditions.

WEATHER MODELS

Three-dimensional creations show what makes weather.

WORKING models that show what weather is made of have been built by Eric Sloane, a flying artist whose work often appears in POPULAR SCIENCE MONTHLY. He and an associate have converted a squash court into "Airology Laboratories" where they make three-dimensional displays from clay, wood, and plastics to aid instruction in meteorology. The Navy already has ordered the models for preflight schools, and work on aerology exhibits has been started at the American Museum of Natural History.

The student gets a sort of eagle's-eye view of a large section of the atmosphere. Clouds are made of colored raw silk, and air currents are indicated by arrow-pointed wires. Warm, rising air is shown in red, and cold, descending air in blue. Moving lights concealed in the background give an illusion of movement.

ERIC SLOANE, noted cloud artist, puts finishing touches on one of original weather models.

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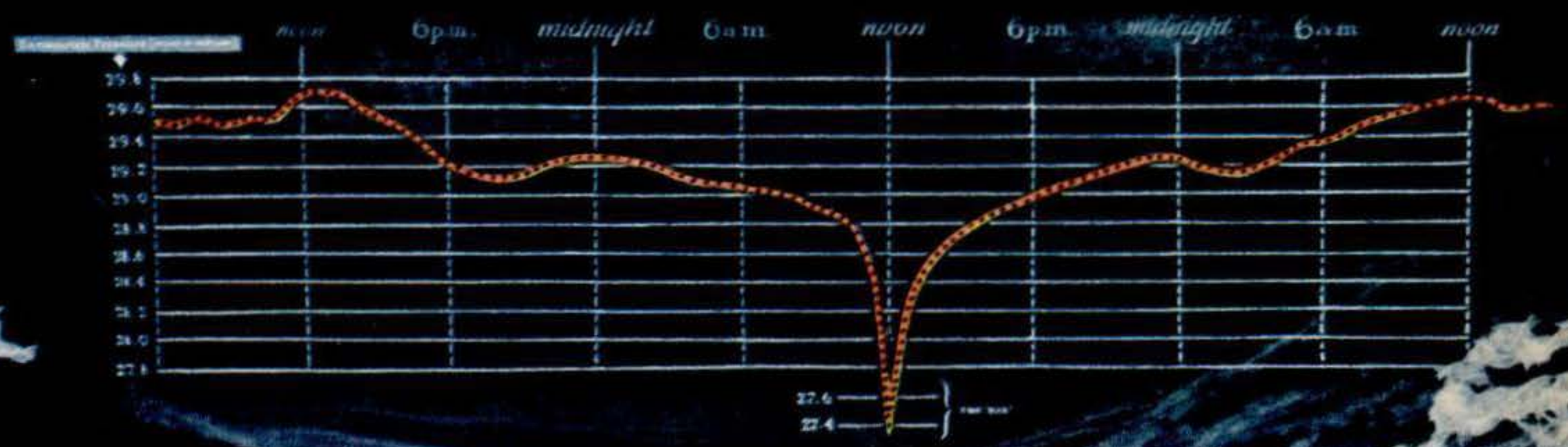
A COLD FRONT. This Sloane model graphically tells airmen what a cold front is and how to recognize it in the sky. Also, it gives students of meteorology a view that could hardly be obtained in any other way. Red and blue arrow-pointed wires show clearly the way warm and cold air masses are moving

A HURRICANE. Five-foot model shows how a tropical hurricane would look from high above it and many miles away. The graph shows barometric pressures; wind velocities and directions are indicated at the bottom. The calm "eye" in center of the storm is created by the centrifugal force of the rapidly revolving air.



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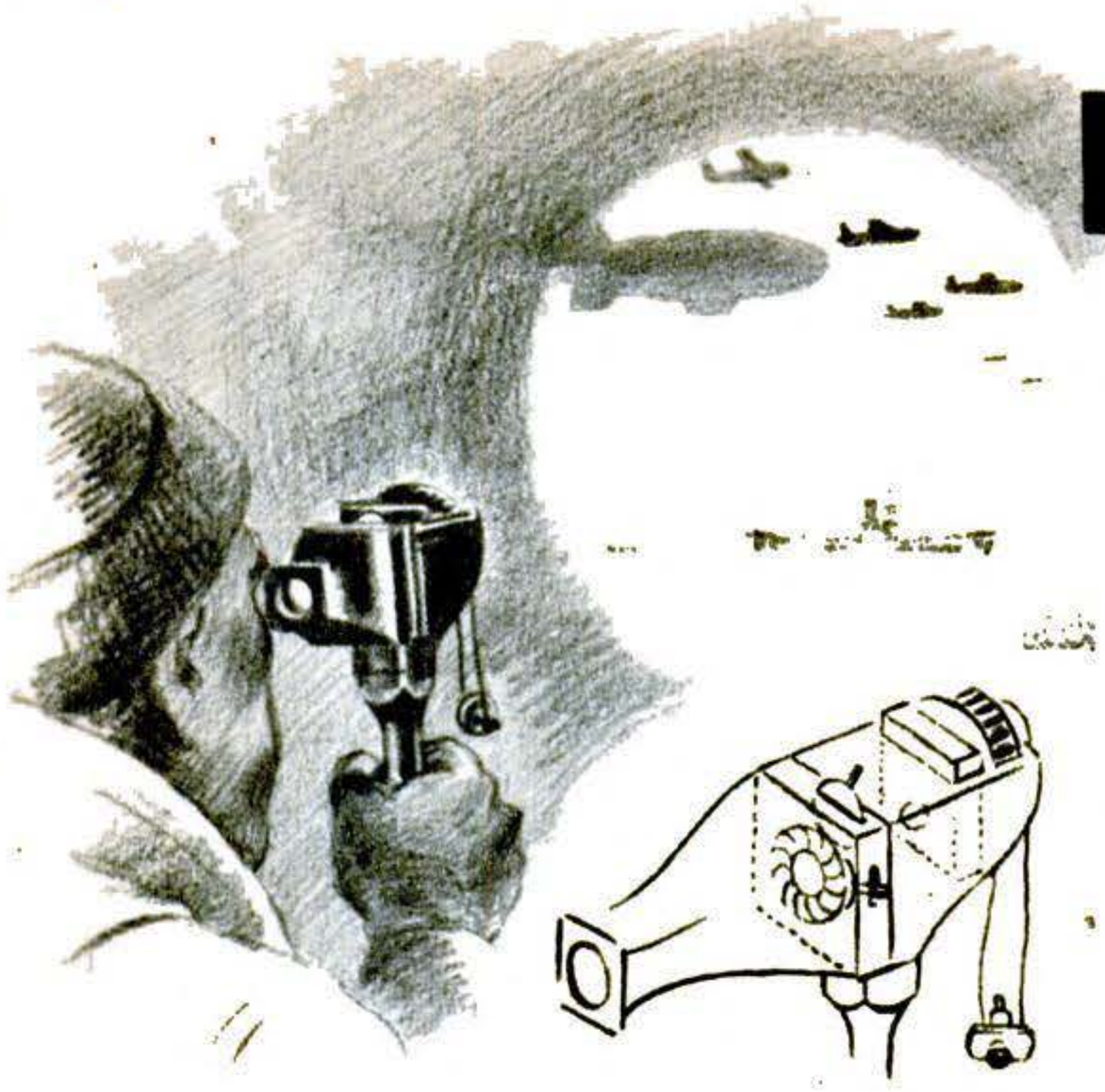
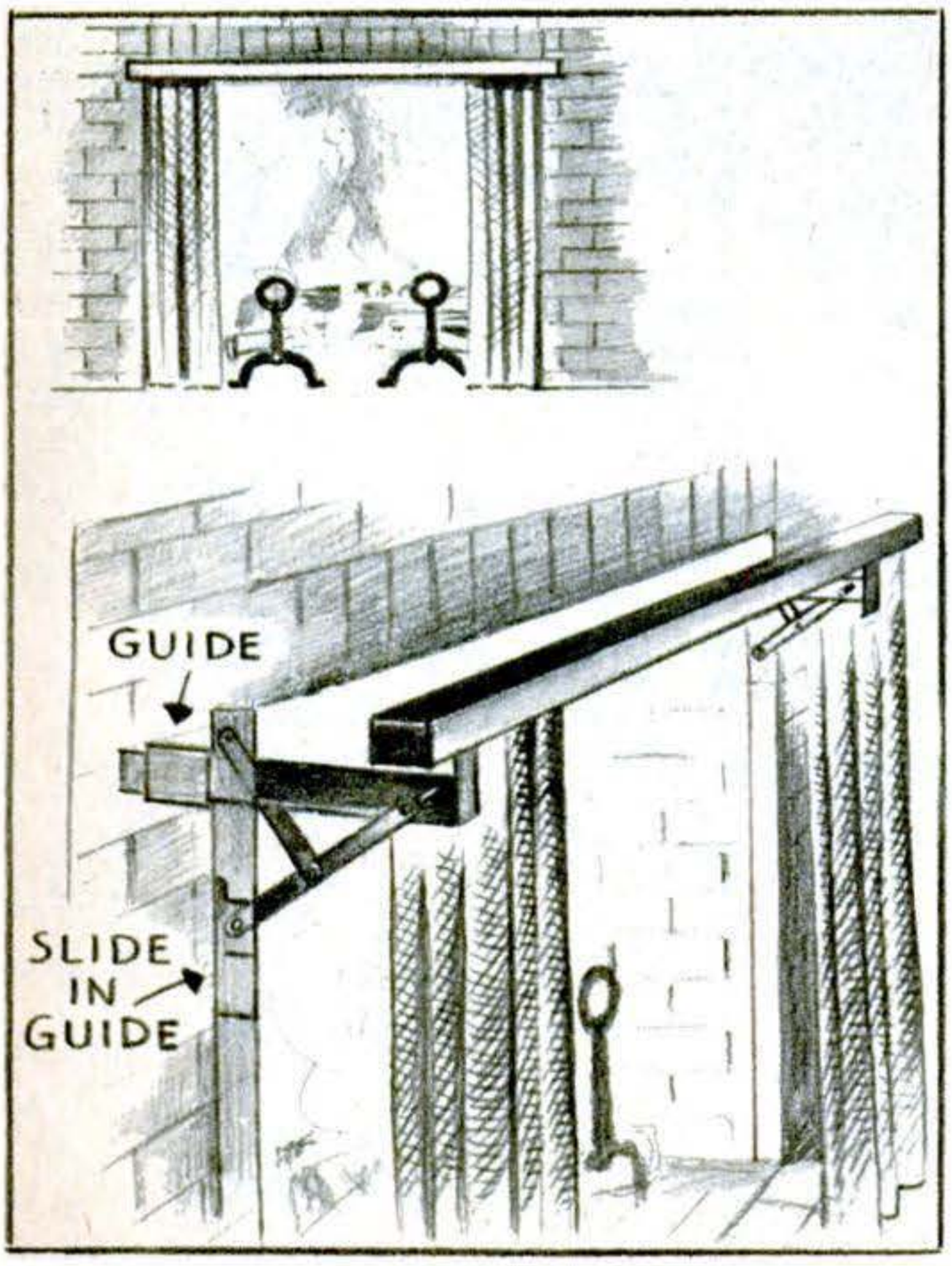
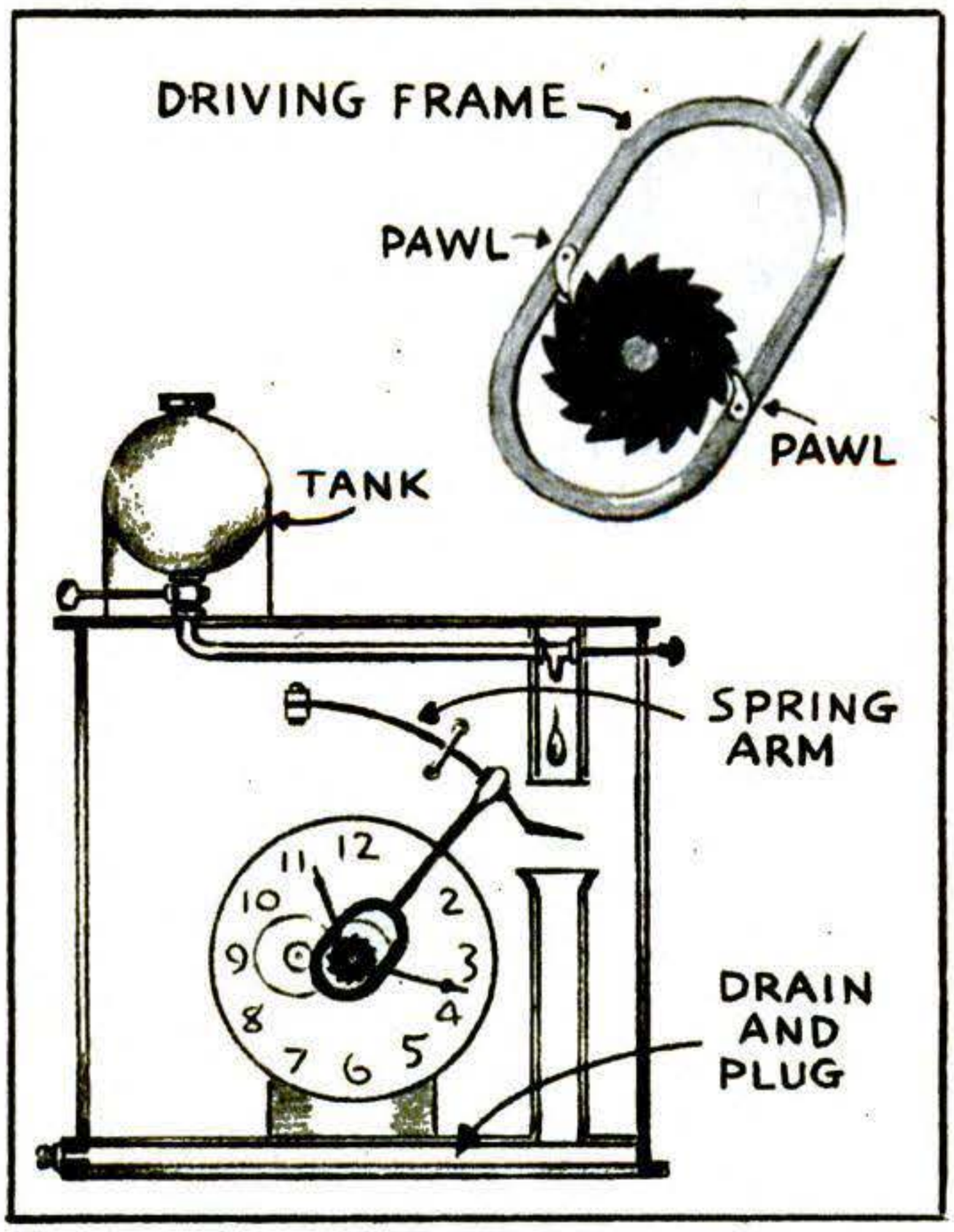
NEW IDEAS FROM



SEEING AT NIGHT or in the dark is aided by the device at the left, invented by David Gordon of Bridgeport, Conn. Looking into the instrument with one eye, the observer sees a spot of light that is controlled as to size and intensity. This gives the appearance to the other eye that the light is projected or flashed on the scene observed. As shown in the drawing, the sky becomes lighter while the objects, which are originally darker in color, remain black. The instrument is regulated by a rheostat controlled by batteries, and contains a bulb that gives off light to a ground glass and a hole in a film.

A FIREPLACE SCREEN of metal draw curtains that are not harmed by hot fires, and never get too hot to handle (below), has been designed by James F. Shannon, Bellevue, Wash. Two upright supporting members fixed within the combustion chamber of a fireplace hold collapsible metal screens in such a way that they may be moved toward and away from the fireplace. Such screens may be made of metal mesh or other flexible material and are so supported on the collapsible framework that they may be moved to either side at will, to prevent discoloration and warping of the mesh.





FLUID RUNS THIS CLOCK, and its inventor, Patrick McAuliffe, of New York City, claims it will operate with precision though it uses only the basic elements necessary in a liquid timepiece. Water or any other desirable liquid runs off from the supply tank through a conduit having a discharge opening from which the fluid can drop. The drops fall on the panlike end of a spring arm that is attached to a drive arm. This drive means has a frame with a pair of opposite pivotal pawls and a ratchet wheel on the shaft located within the confines of the frame and with which the pawls engage. The weight of the liquid trips the pawls, moving the clock hands.

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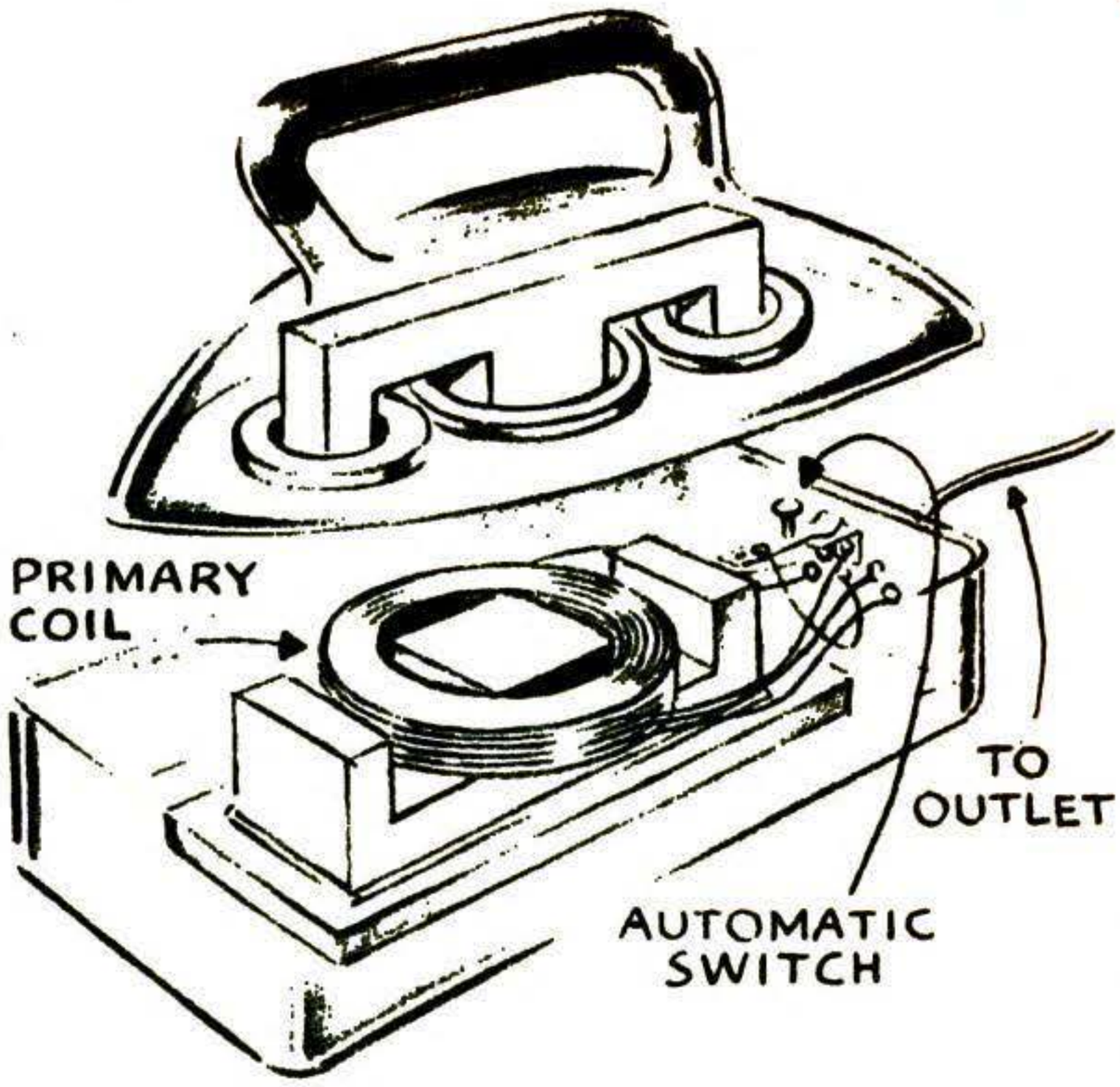
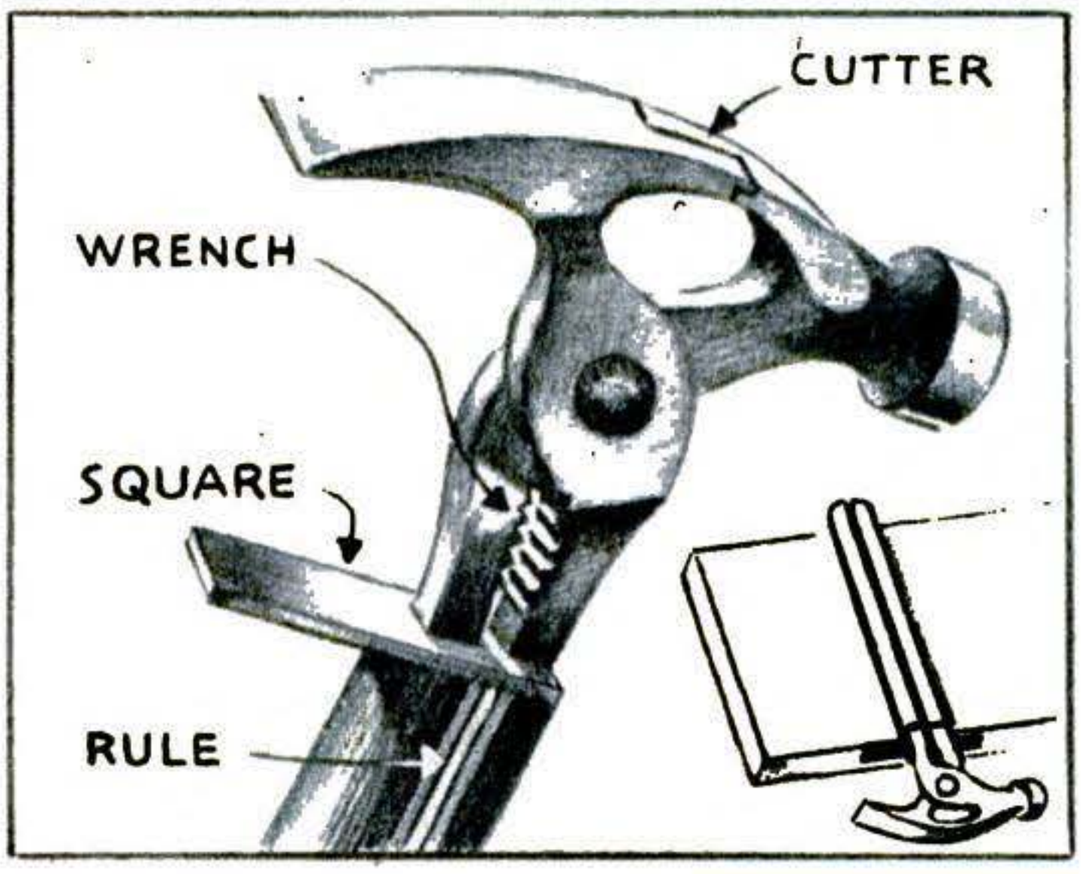
THE INVENTORS

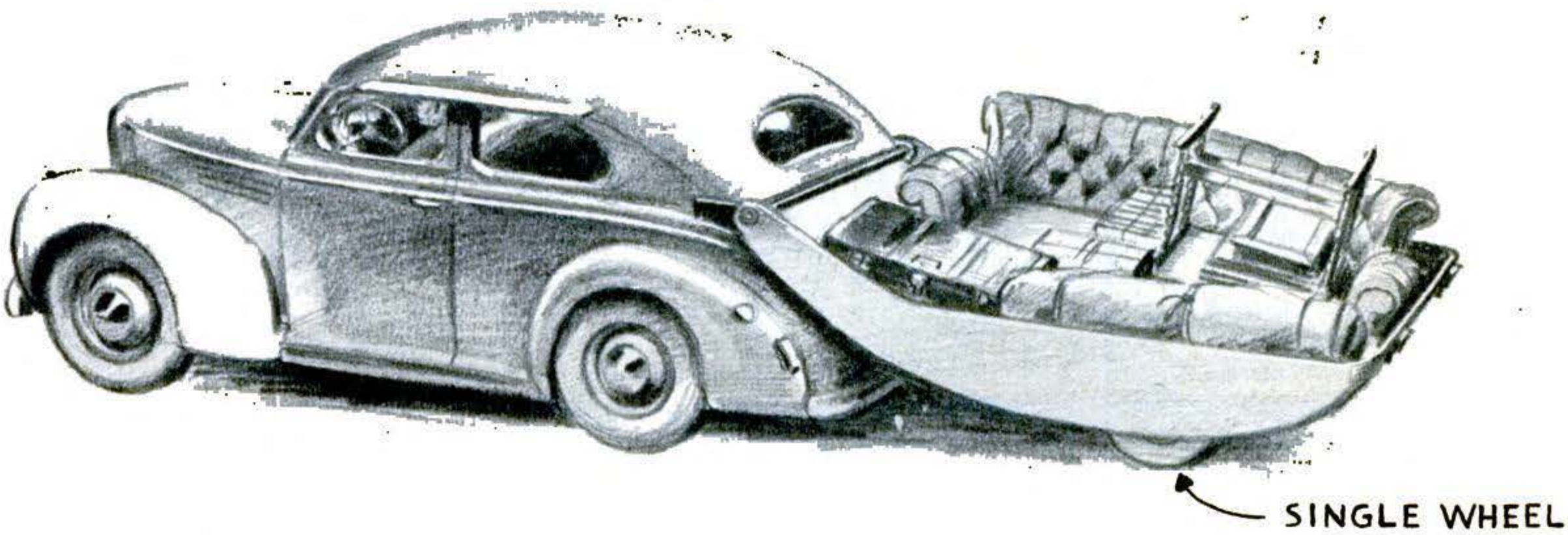
A SOLDIER'S GIFT TO WOMEN is this cordless electric flatiron, the bright idea of Lawrence F. Black, U. S. Army. The iron is heated inductively when set on a base containing a primary coil connected to the supply of electricity. Copper rings inside the sole plate of the flatiron are inductively energized by the primary coil as long as the iron rests on its base. In this way, heat is distributed uniformly to the ironing surface, and the housewife can move her flatiron as far as she likes in any direction without being limited by a cord. The instant she lifts the iron from its base, an automatic pressure switch cuts off the current.





TOOL-OF-ALL-TRADES is claimed to be a potential master of more than one by its inventor, Herman Folkers, of Omaha, Neb. It is a combination claw hammer, cutter, rule, square, and wrench. Its half-round handles pivot in a metal jaw under the hammer head, which parts in the middle with a cutting blade on each side. The jaws are saw-toothed below the pivot bolt. A plate fastened at right angles to one handle at its business end forms part of a square when the handles are open; when they are closed, it holds them parallel but slightly apart, enabling the user to grip them firmly. Metal rules are fastened to the inner, flat surfaces of the handles.

A CAR WITH TWO TOPS, one of which could swing back to form a trailer, is a possibility based on an idea of Thomas J. Collings, of New York, N. Y. Mr. Collings proposes that a hinged top with a single wheel in the center be built on small, light cars. He suggests that the shell-shaped top be made of plastic or of exceptionally light metal, and he points out that because of its wide hinge the top, when used as a trailer, would be firmly balanced on its single wheel. In climates where sunshine can be depended upon, one top might suffice; it seems safer, however, to have two: the fixed top to keep out the rain while the hinged one carries the family's freight.



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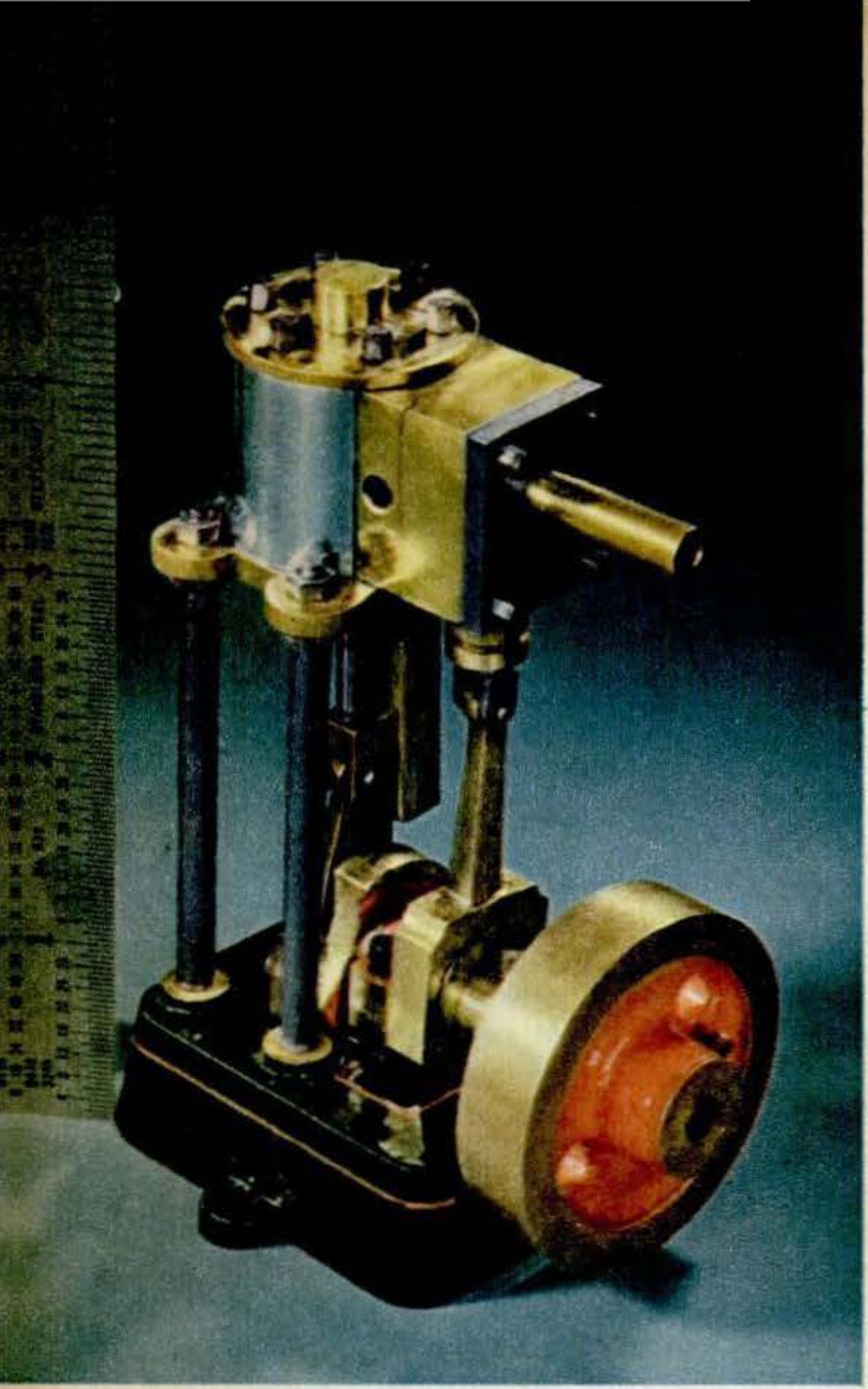

Three Projects of the Month for Craftwork Hobbyists

Now that you have your set of castings in a prepared kit, how are you going to turn it into that model steam engine on which you have long had your heart fixed? While all such kits include blueprints, the beginner is likely to find many of the steps puzzling. Starting on page 178 is a detailed description of how to machine and build the little vertical slide-valve steam engine shown at the left. It is accompanied by a series of photographs especially selected to make clear the key construction steps.

In a different vein, but equally appealing, are the two projects shown below—a table lamp made from an ordinary bean pot and an ornamental pheasant pin carved from wood. How the lamp is made is told on page 155; the pin is described on page 150.

Built from castings obtained in kit form, the tiny steam engine shown at left is less than 4½" from its base to the top of its cylinder head. It is a powerful performer for its size, a consistently good runner, and a fine little showpiece as well.

The homespun but attractive lines of a crockery bean pot make it just the thing for a table lamp. After wiring, this one was further enhanced by the application of Pennsylvania Dutch decals.

Ordinary soft pine can be used in carving out this decorative pin to be worn on lapel or sweater. The wood works easily under a knife, and the completed pheasant is finished in natural color with enamels.

Homebuilt Vacation Trailer Has Sleeping and Storage Space

THE call of the open road has sounded pretty faint and hoarse these last few years, but now, at last, there's a peacetime summer on the way.

And that's not all. Millions of vacation-hungry Americans are also getting under way—making plans, charting routes, readying equipment.

In case you've forgotten what it's like, vacationing by car takes more than an unlimited gas supply. But the Wanderbug trailer, shown here, has what it takes—light weight, road appeal, plenty of sleeping and storage space, and all the fixings for a month away from sidewalks and shops.

You can't buy the Wanderbug, but you can build it from scratch at surprisingly low cost. Drawings and instructions begin this month on page 146. Start work now for a happy summer on the road.

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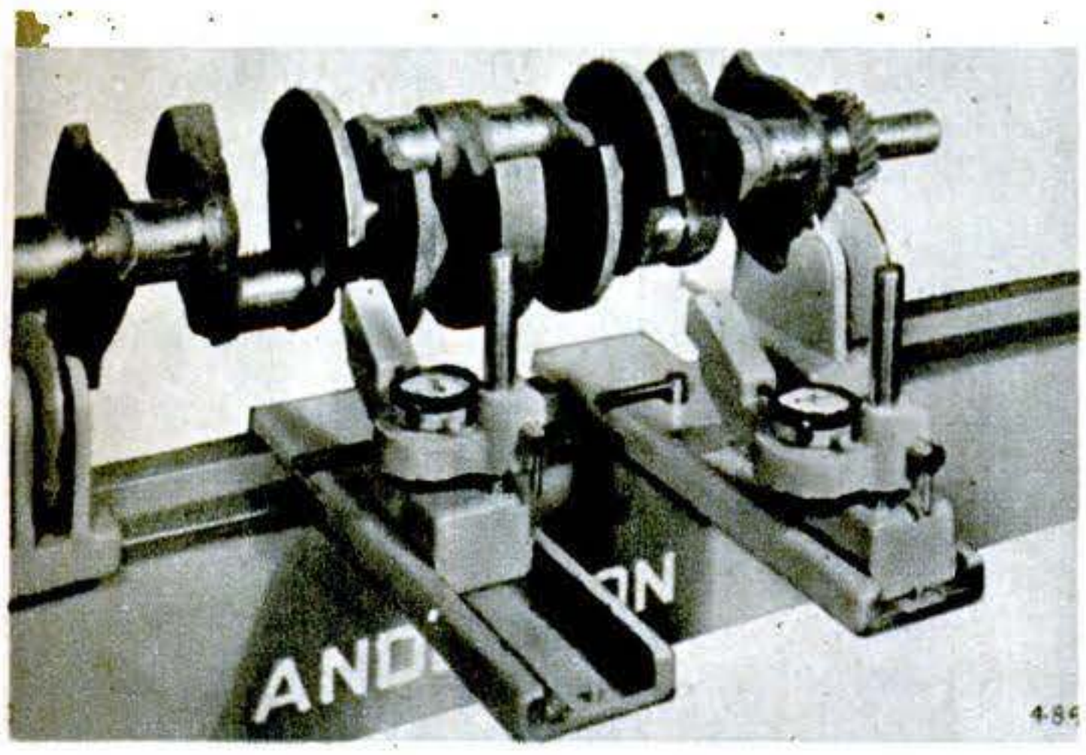
NEW TOOLS

Bench-Operated Unit Tests Metal Hardness

THE compact unit shown at the right permits the small shop, laboratory, or school to test metals for hardness. Requiring little room on any workbench, it is manually operated and tests by the multiple-beam and dead-weight principle. Accurately calibrated for weight loads from 500 to 3,000 kilograms (1,100 to 6,600 pounds), an integral hydraulic unit in the mechanism prevents shock to the test specimen as the load is applied.

The new tester is furnished with a flat anvil for holding a flat-surfaced test piece, as well as a V-anvil for taking care of round samples.

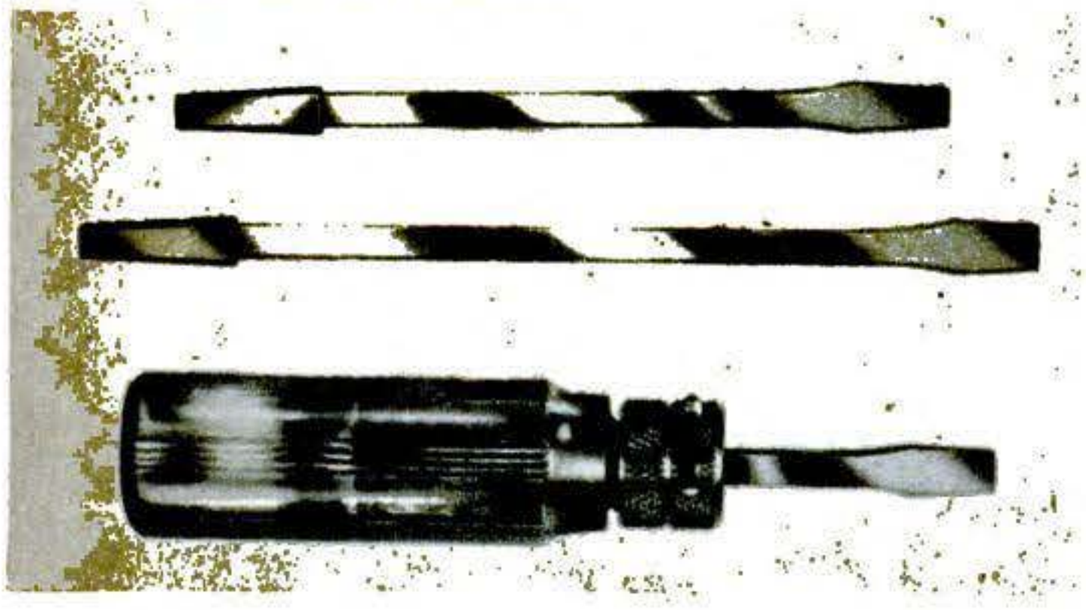


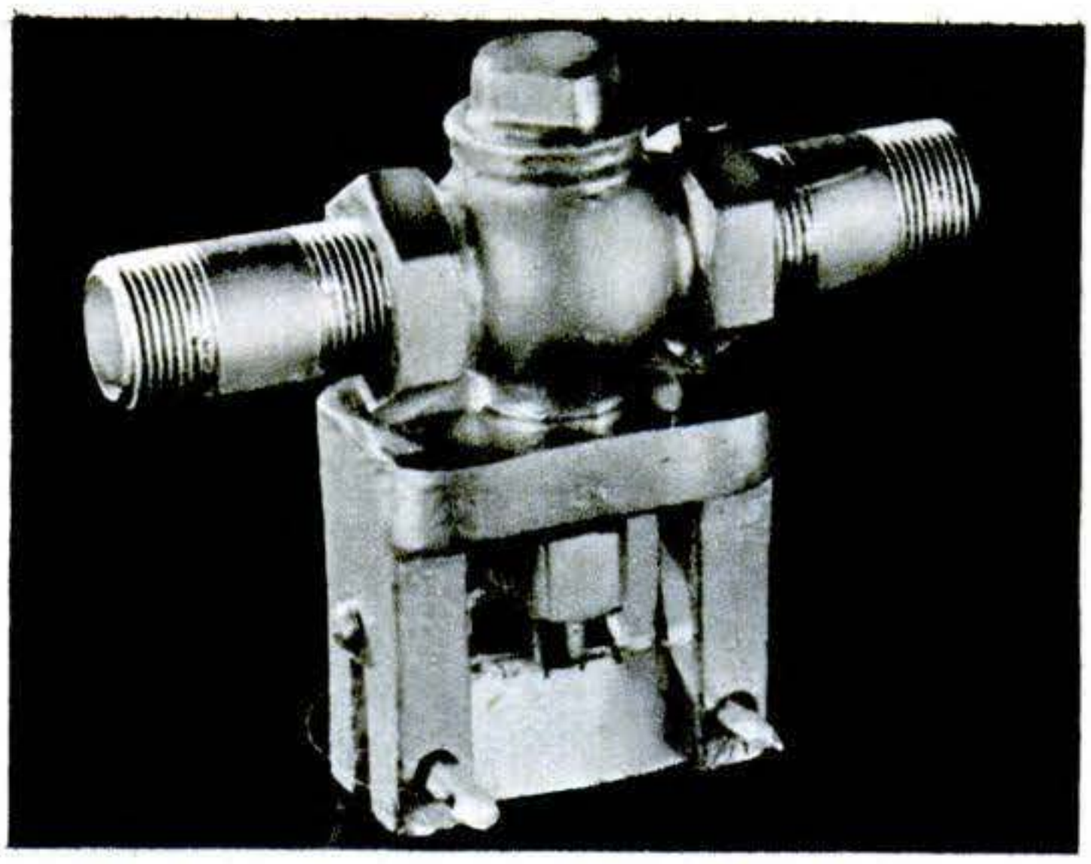
Device Speeds Check-Up of Crankshaft Bearings

THE checking of crankshaft bearings is speeded up when the Roto-Checker at the left is used. The crankshaft is placed on four rotating disks, and an indicator for each bearing, if desired, is brought into position. The crankshaft then is revolved, and the slightest deviation from trueness is defined. The disks, borne on a base 42 or 64 inches long, roll on supersensitive ball bearings. Larger checkers are planned to meet special requirements.

Come-Apart Screwdriver Will Take Any Size Screw

THE Day Tool Driver and blades (below) offer a simple, effective means of having any size screwdriver immediately available to fit the job at hand. The tool is made in two sizes: a plastic handle with locking nut and four blades ranging from 8 to 14 inches in length and one with four blades ranging from 1½ to 5½ inches.





Valve Prevents Gas Explosion

A CUT-OFF valve, made of Vinylite plastic, is specially formulated to spread, break, or deform at 140 degrees F., causing the valve stem in the device to stop the flow of gas in case of fire.

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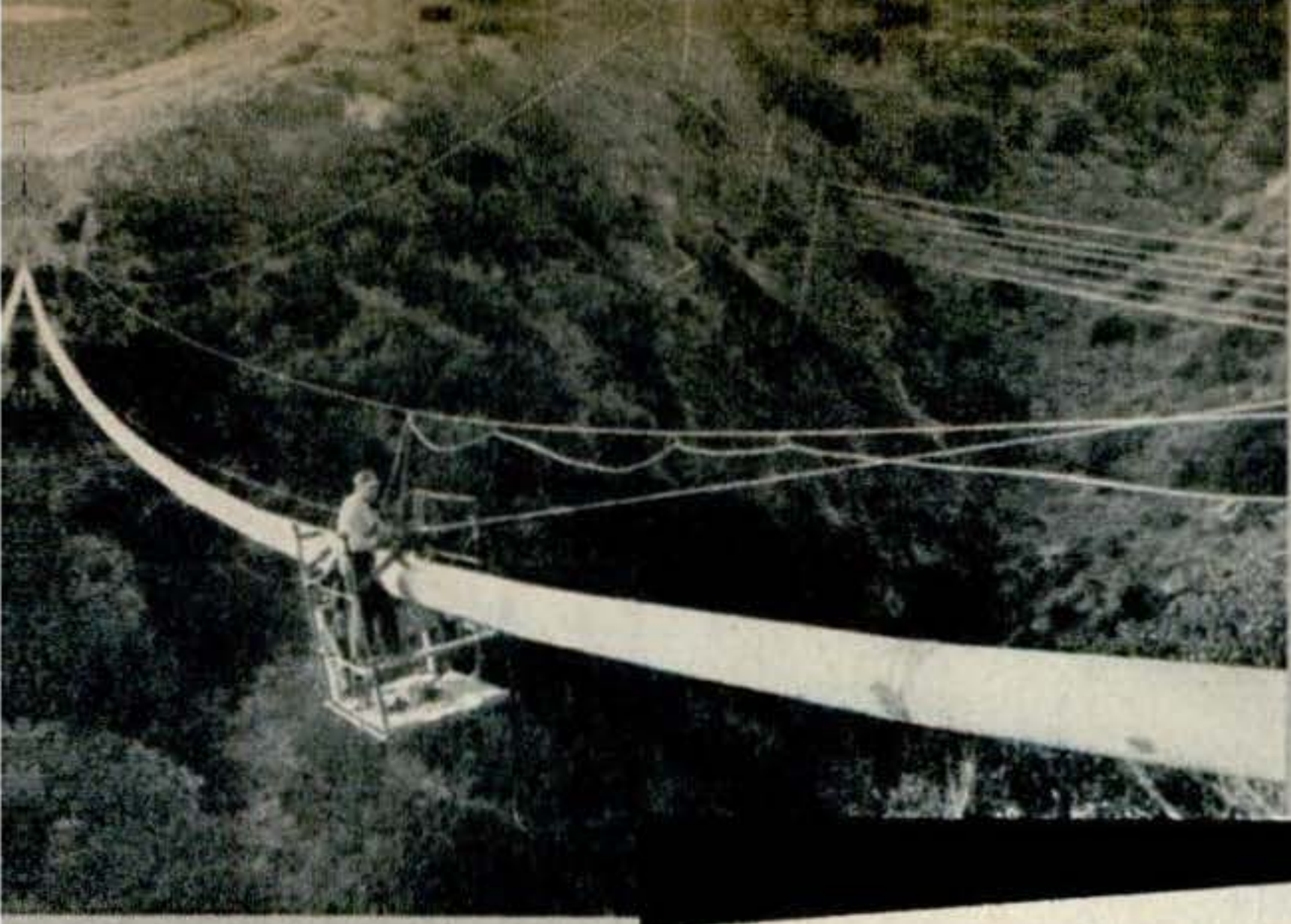
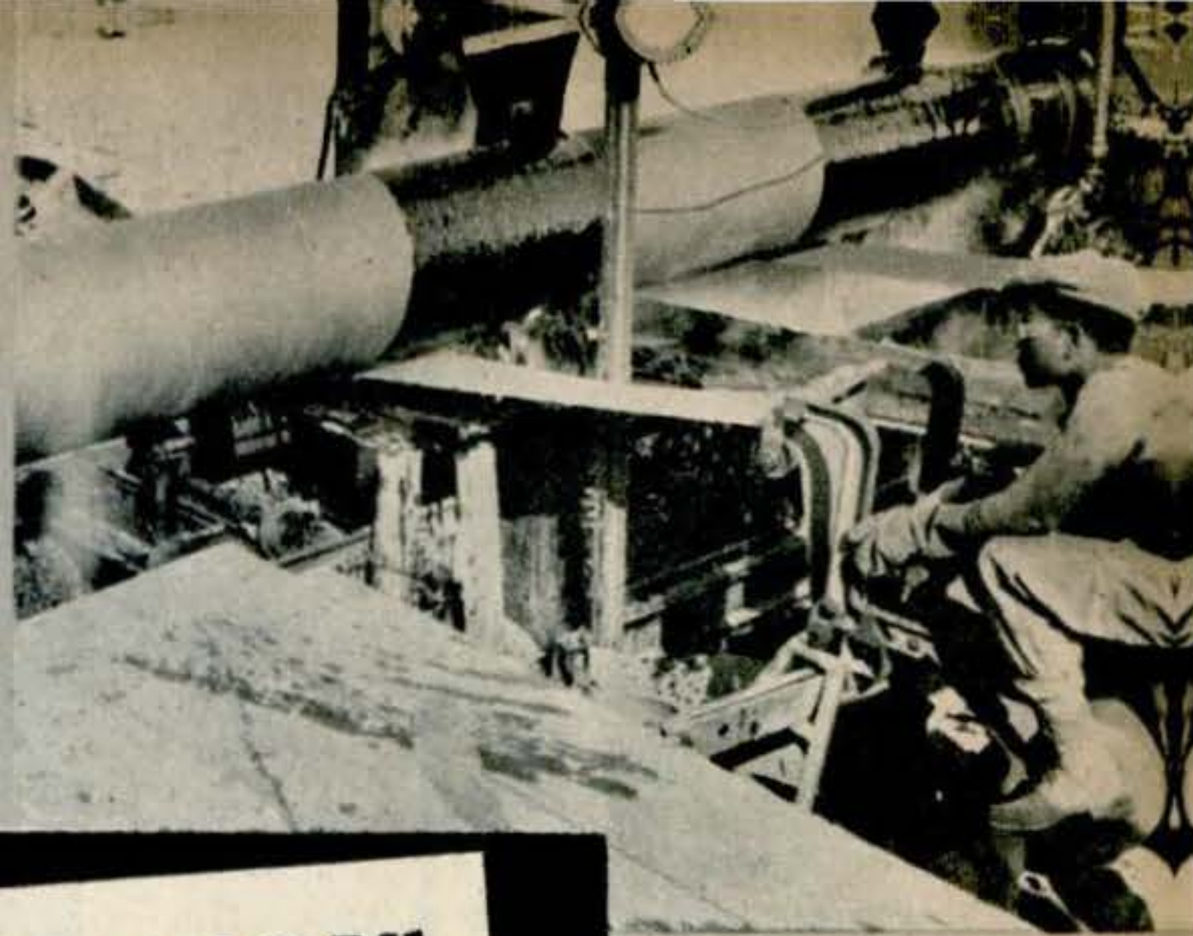


The big pipe line that taps La Goleta field for Los Angeles spans canyons along its mountainous southward route. Gas stored underground the previous summer is drawn upon in winter, when the city uses six times its normal supply.



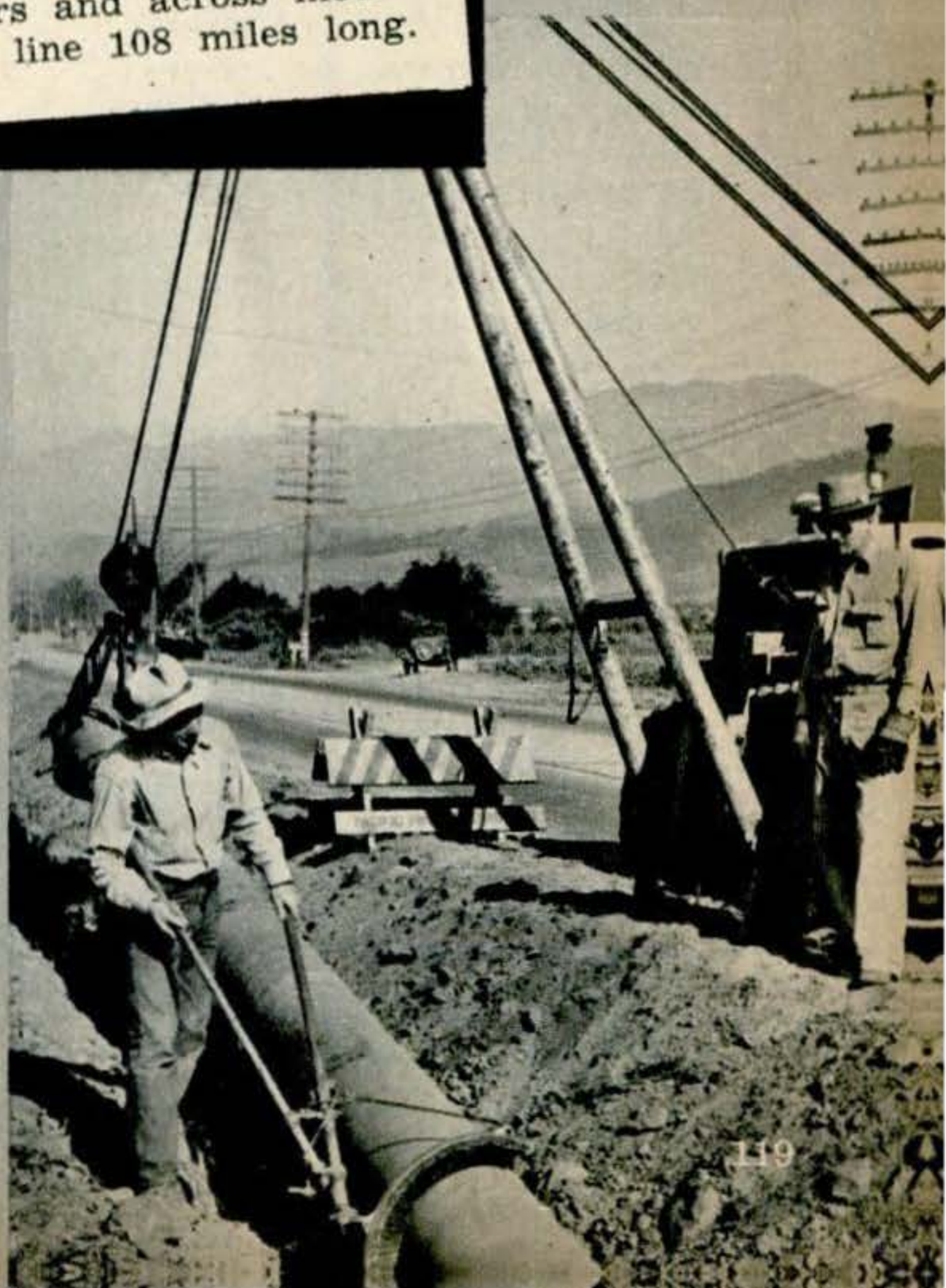
Protection for 30 years was given each length of pipe line by coating and wrapping it with alternate layers of paper and tar. The underground "pool" from which it pipes gas holds enough to supply the entire country for two days.

VAST GAS "SPONGE" Fuels Los Angeles

NATURAL gas from the world's largest "tank," an underground reservoir that lies in sands capped by Lower Miocene shales 4,000 feet below the surface at La Goleta, Calif., fuels the industries and heats the homes of Los Angeles in winter. The La Goleta field is two miles long, a half mile wide, 400 feet thick. Calculations from pressures showed that its sands, which are like a vast sponge, held 47,000,000,000 cubic feet of natural gas before pumping started. That's eight times as much as all the surface gas-storage tanks in the United States can handle.

Big pumps from near-by fields force additional gas into La Goleta for storage; in winter they suck it out again and start it flowing southward, under rivers and across mountains, through a pipe line 108 miles long.

This is not a gas leak. It is the blowoff that took place at the end of each mile during the construction of the long gas pipe for two leading Southern California companies. Air periodically was blown through the line to clear it of accumulated dust and dirt.

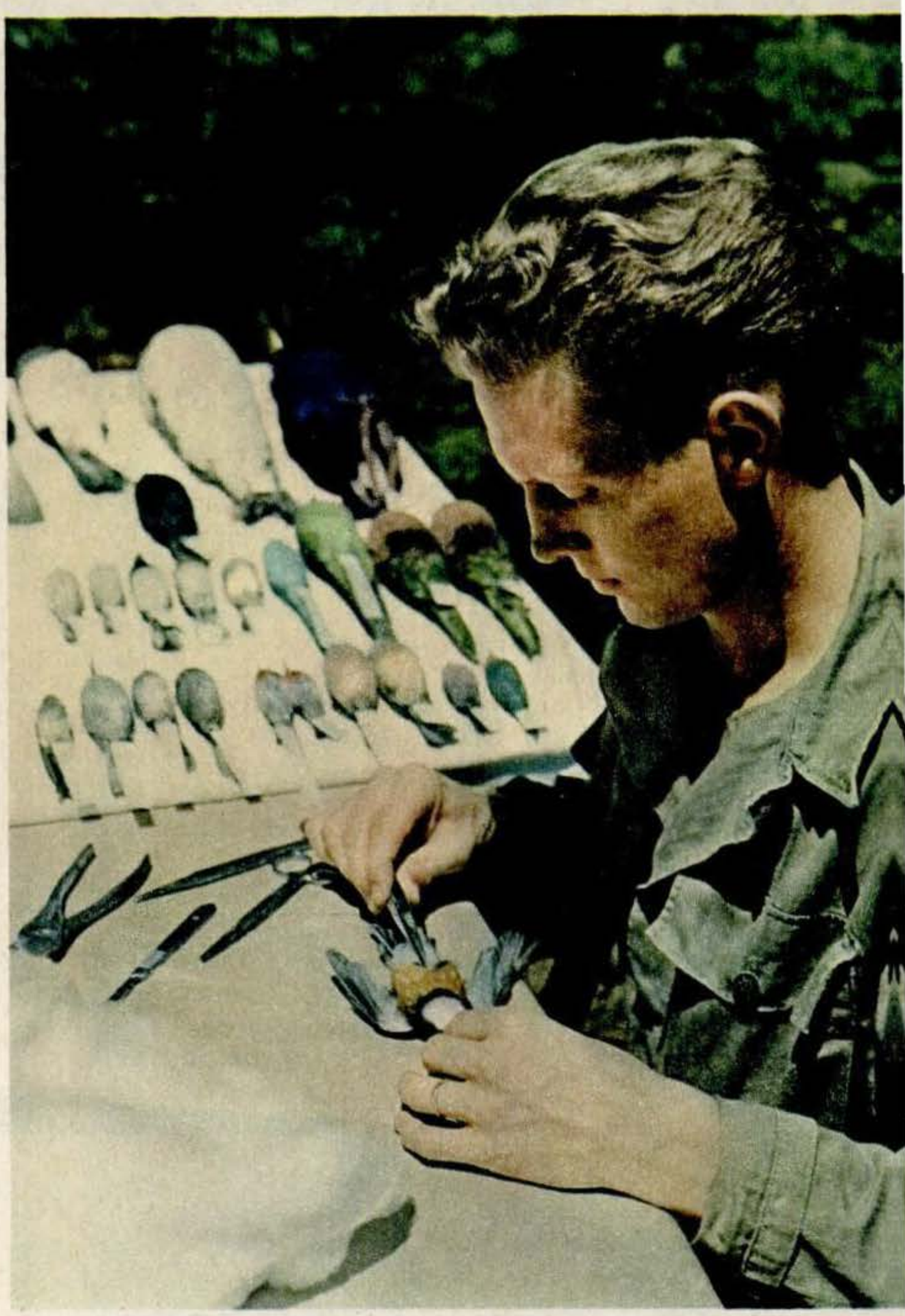


A workman tests the pipe for imperfections with a semicircular electric brush. Changes in resistance tell him when he has found a flaw. Narrow "sheep's foot" rollers—swung from tractors—packed earth over the pipe as each length of it was laid.

GI TAXIDERMISTS

Science-minded soldiers spent off-duty time collecting rare species of wild life on tropical New Caledonia.

THOUSANDS of unusual specimens of bird, insect, and marine life are on exhibit today in a number of U. S. colleges, universities, and museums because a few GIs practiced taxidermy in the jungles of New Caledonia, a zoological wonderland just inside the tropics, 1,000 miles northeast of Australia. The young scientists, all zoologists in civilian days, improvised nets, traps, and fishing tackle, doctored rifle shells, and concocted preserving solutions in doing the extraordinary research work that would have cost some museum thousands of dollars, but cost nothing as a by-product of war. Their "catch" included mud skippers, tree-going fish; frog mouths, night-feeding birds with cavernous bills; the rare wood rail; the fruit bat, an edible, three-pound bat with a four-foot wing spread; insects that thrived in the fog-drenched mountains; brilliant pint-sized parakeets, a species last captured in the early 1800's, and many hundreds of specimens of marine life. All this was done in their spare time from their regular Army assignments.



A portable table was the jungle "operating room" for four soldier-scientists studying wild life on New Caledonia. Here, Pfc. Warner prepares to stuff a rare tropical bird before shipping it to the U.S.

Warner examines a bird winged by the four GI-scientists whose hunting grounds ranged from the depths of the sea to 5,000-foot "cloud mountains." Scientifically, New Caledonia was almost unexplored; some species of wild life collected by the group are the first taken in over 100 years.

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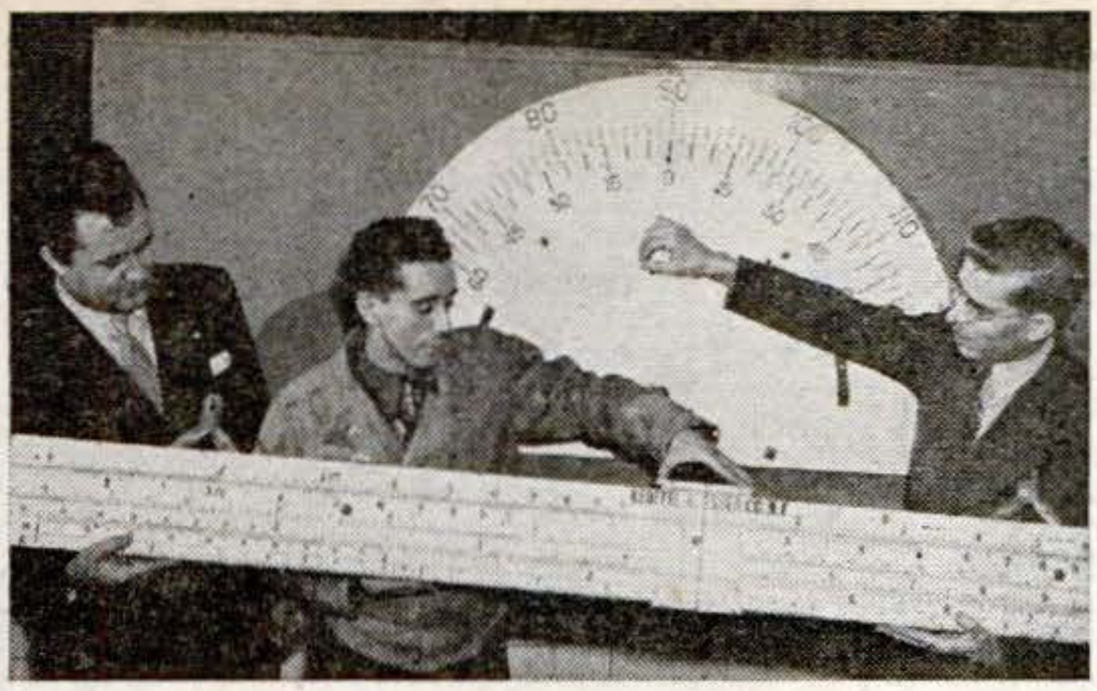
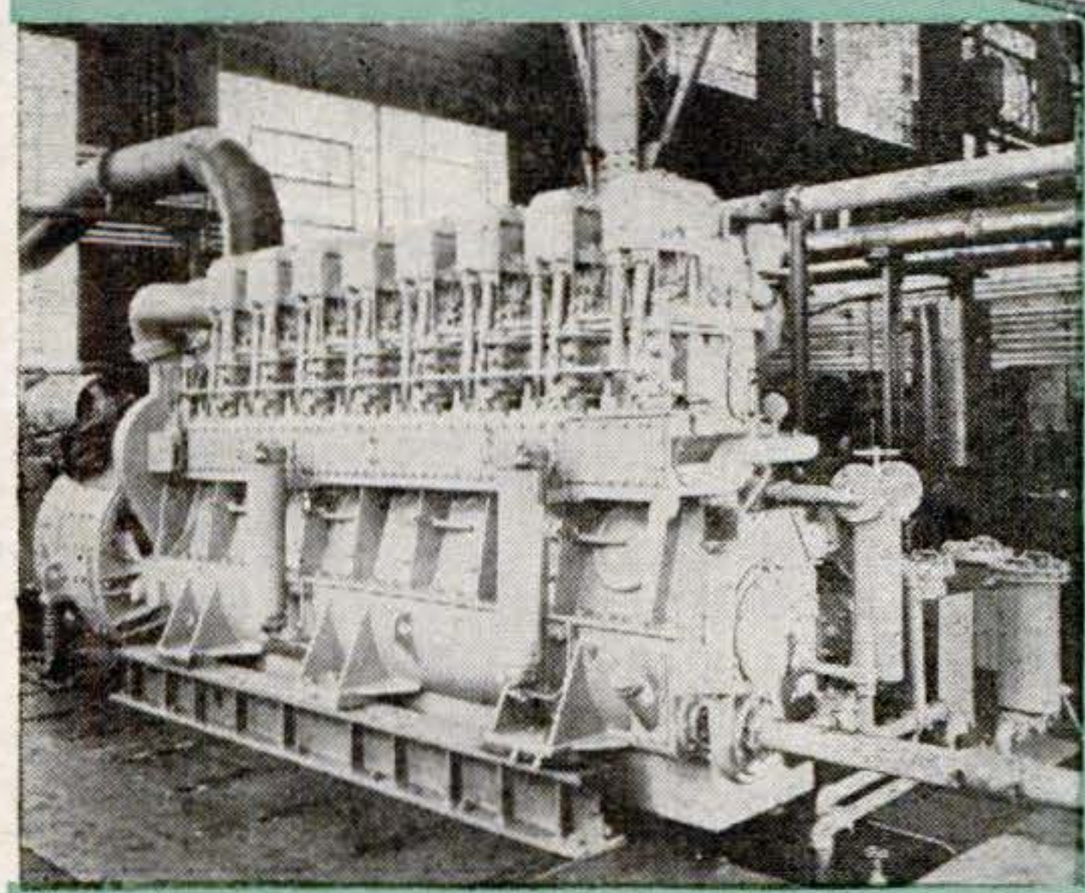
Trainees at Ford Plant Learn to Measure on a Big Scale



These scale models of protractor, slide rule, and (right) micrometer are 20 times larger than normal.

INSTRUCTION in the use of calculating and measuring instruments has been simplified in the Ford Motor Co.'s training division by the use of oversize scale models. These giant instruments are ideal for classes; anyone can read the settings 30 feet away.

Most Powerful Diesel Locomotive Develops 3,000 Horsepower



Two 1,000-hp. engines, their power boosted considerably by turbosuperchargers, run the Diesel.

THE most powerful Diesel-electric locomotive in the world, generating 3,000 horsepower, has been put into heavy fast-freight service on the Seaboard Air Line Railway. Two Diesels, each having eight cylinders in line, give the giant locomotive a third more power than any other prime mover of this kind. Capable of 120 miles an hour, the "Rail Master," as it is called, will be held to 85 m.p.h. top speed on the Seaboard. It was built in a record four months by the Baldwin Locomotive Works, is nearly 92 feet long, weighs 288½ tons, including 3,800 gallons of fuel and lubricating oil, and 600 gallons of engine-cooling water.

Sandless Glass *speeds up* Lenses

IT BENDS LIGHT BETTER AND WITH LESS DISPERSION

By GOLD V. SANDERS

FOR 40 centuries, the human race has made all of its glass from sand, whether for windows, table use, ornaments, or optics. Improved ways of making glass have been invented step by step, but always the principal ingredient has been sand. Even the remarkable optical glass achieved in the '80s by the Germans, Schott and Abbe, on which all subsequent optical advances have been based, was made of sand mixed with barium.

Now comes a new chapter in the long history of glass making. Eastman Kodak research has created optical glass using *no sand at all.* Rare-earth elements—lanthanum, tantalum, and tungsten—are the new ingredients. Since they are all very heavy, this glass is so heavy it can be distinguished by heft. Extremely dense, it has a high degree of power to bend light. But what is more important, it combines this "high refractive index" with a low dispersion (spread) of the colored rays that make up all white light. Normally, in all optical glass, dispersion increases in rough proportion with refractive index. This is simply because the more bending power glass has, the more variation or spread it causes between the red and the violet ends of the spectrum.

It is important in photography to bring the light rays of all colors to a common focus at the plane of the film, since white light consists of these colors. The less the different wave lengths (colors) are dispersed by the lens, the easier it is to accomplish this result. There is a standard technique for doing this by pairing positive and negative lens elements made of glass having different dispersive powers.

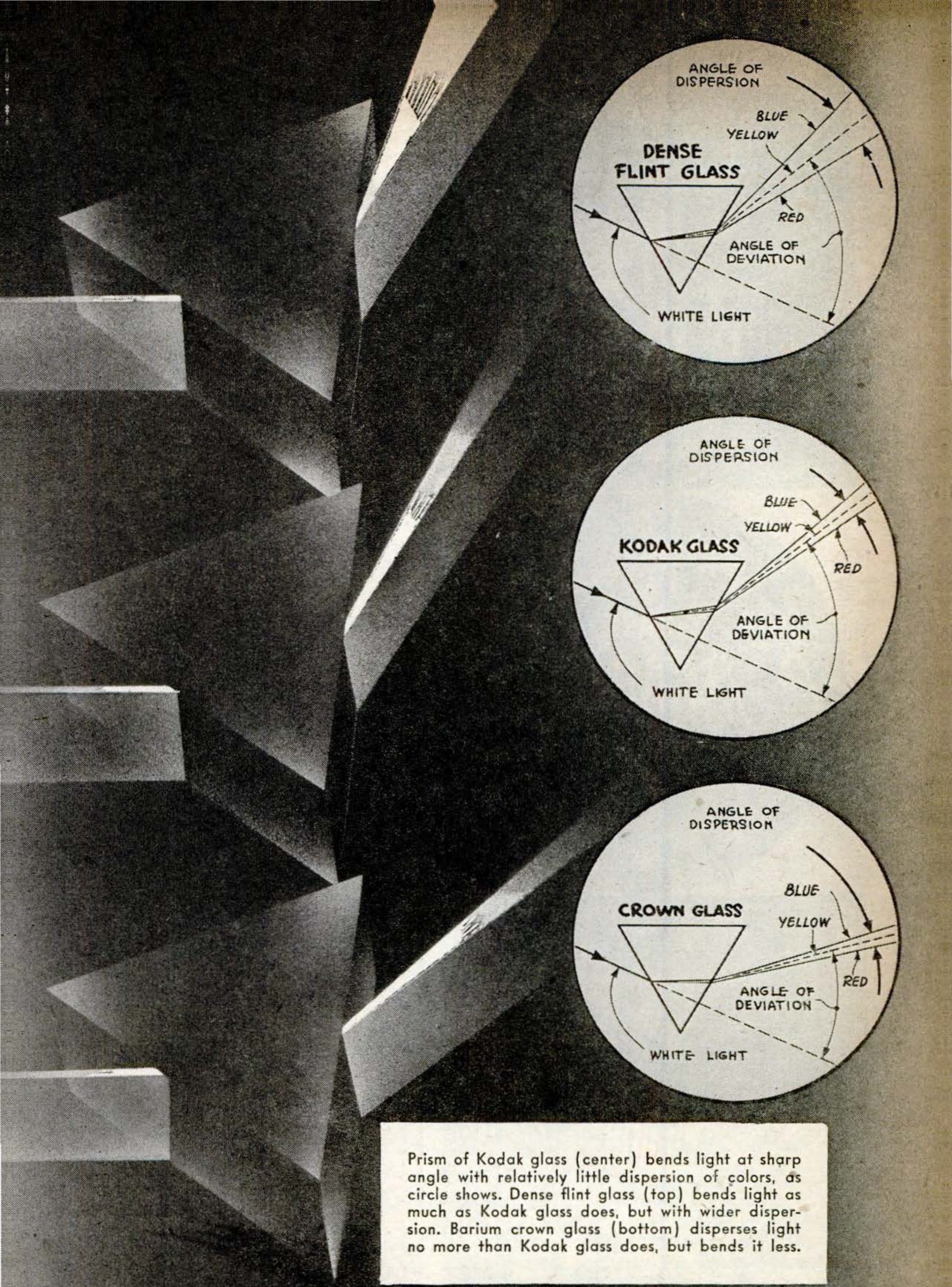
Because of its high index, the new glass makes possible a lens surface of less curvature for a given focal length. Any photographer will understand that this means better lenses. For the curvature of the lens surface causes what is called "spherical aberration." Light rays striking the curved surface form a *sharper* angle near the *outer edge* than near the *center* of the lens. These marginal rays are bent more sharply and therefore focus (converge) *nearer* the lens than rays passing through the center. The flatter the lens, the less difference in angle from center to perimeter—and the more nearly all rays will converge at the same point.

The principal application of the new glass will be in what the photographers call "fast" lenses, such as those having a relative aperture (speed) of f/4.5 and larger. The professional and advanced amateur can expect shortly to have lenses in the popular five- and six-inch focal lengths with a maximum aperture of around f/2. The corrections of these lenses will be even better than those of present lenses of less speed. No lens, of course, is ever completely corrected for all errors.

Lenses of the new glass will be of greatest value in color photography. The faster speed will enable the photographer to take color pictures under conditions now regarded as impracticable with the relatively slow color films available. The improved correction of lenses will give almost equal exposure to the center and edges of the picture. This is more important in the case of color because color film has less margin for error in exposure than black and white film.

The earliest of these highly efficient new optical glasses was perfected in the Eastman research laboratories shortly before the war, and so found first widespread use in lenses for aerial cameras, telescopes, gunsights, and other military optics. An original production of a mere 300 pounds a month was rapidly stepped up to 6,000 pounds a month, so great was the demand of the services.

The efficiency of optical glass is a matter of exact measurement. As soon as a melt of glass has been produced, the optical scientists can find its index and its dispersion value with instruments. These two figures place it in a precise spot on a standard optical chart, along with every important type of optical glass previously created. Any optical scientist will rub his eyes when he sees how far Kodak glasses have stepped into what heretofore has been an optical no man's land. The six new rare-element glasses developed by Eastman range from 1.69 to 1.85 refractive index,



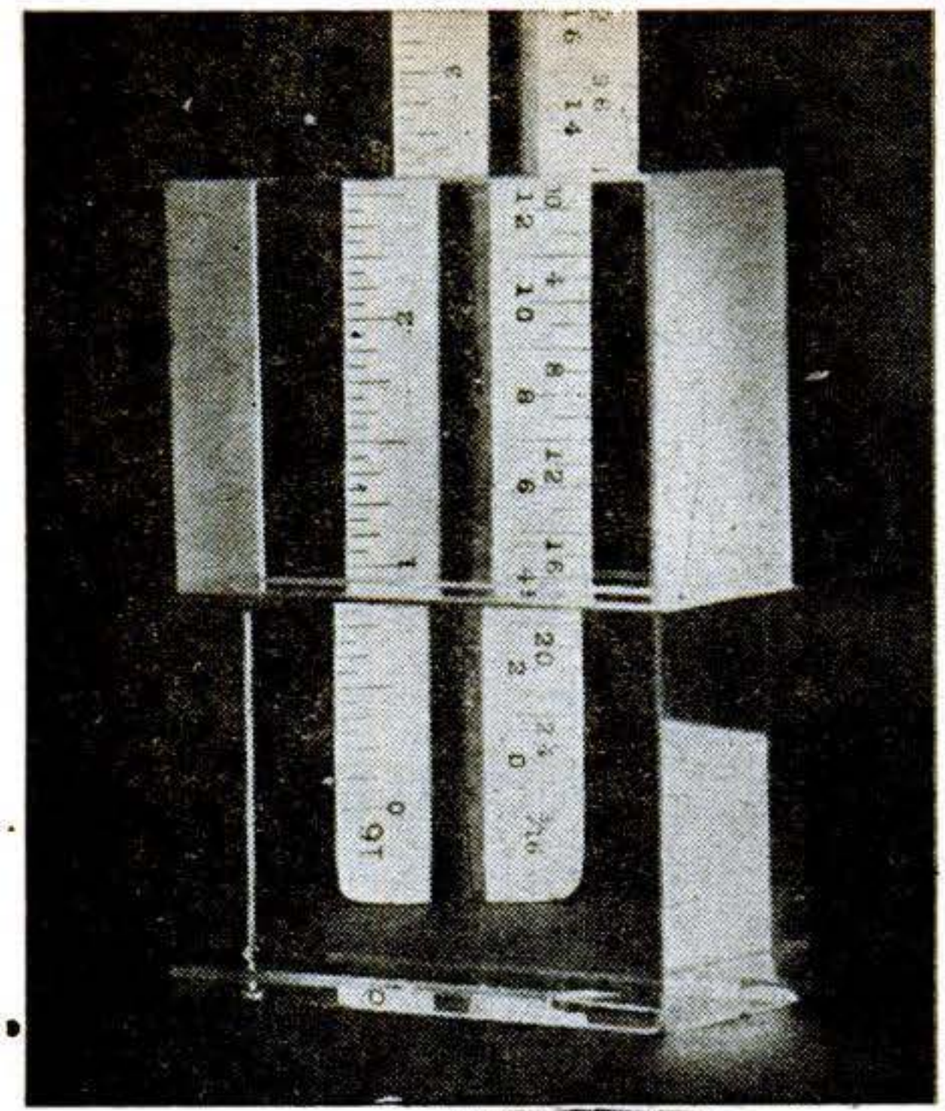
Prism of Kodak glass (center) bends light at sharp angle with relatively little dispersion of colors, as circle shows. Dense flint glass (top) bends light as much as Kodak glass does, but with wider dispersion. Barium crown glass (bottom) disperses light no more than Kodak glass does, but bends it less.

and from 40 to 56 "V value"—the designation of dispersion property.

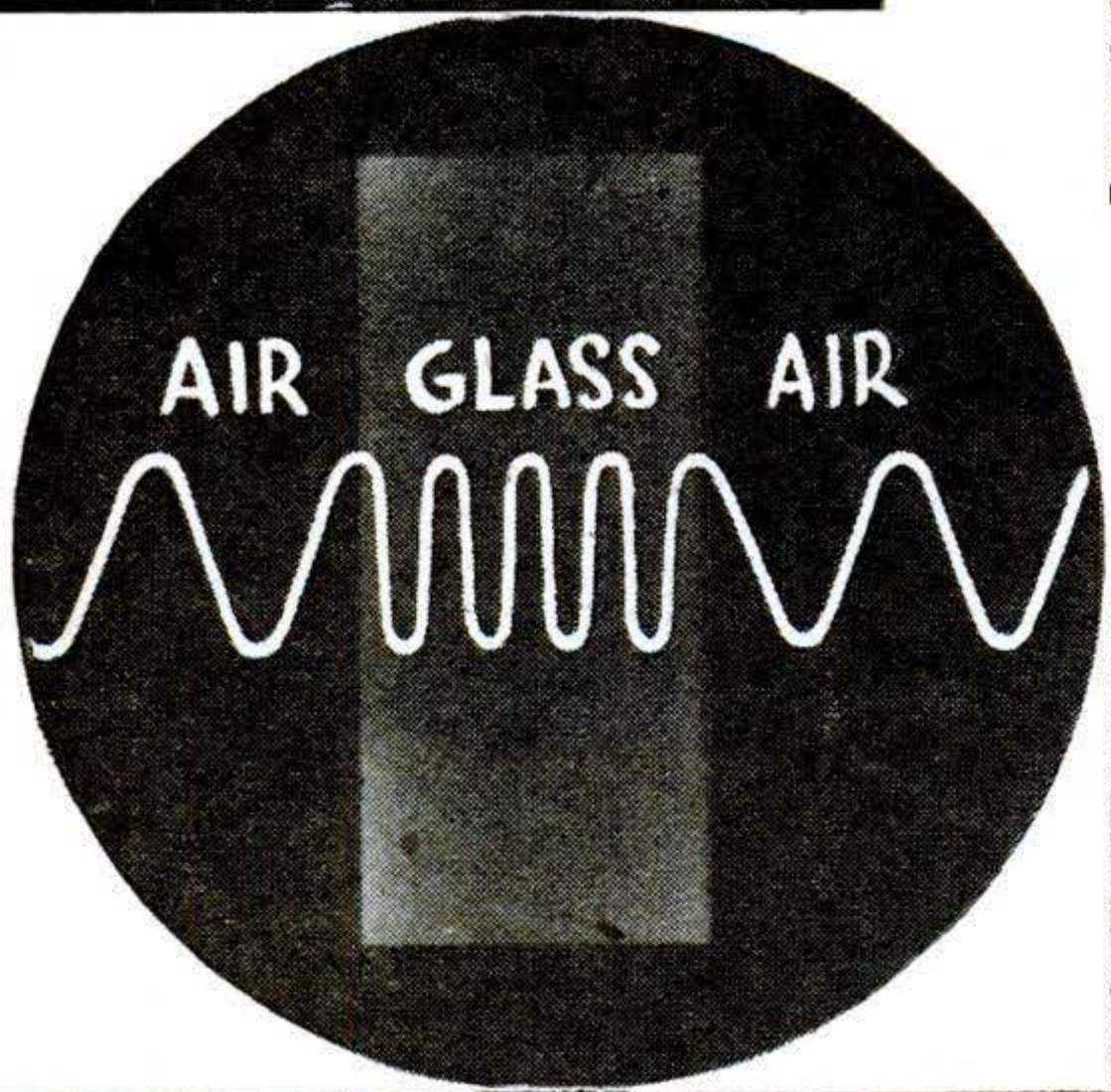
The new Kodak glasses are neither the highest among optical glasses in refractive index nor the lowest in dispersion, but they rank extremely high in *both respects at once.*

The Germans made a similarly notable advance with their Jena glass in 1886. Thereafter, for several years, there was rapid progress in the design of more efficient lenses everywhere. This eventually came to a halt when the potential powers of the glass were used completely by the designers.

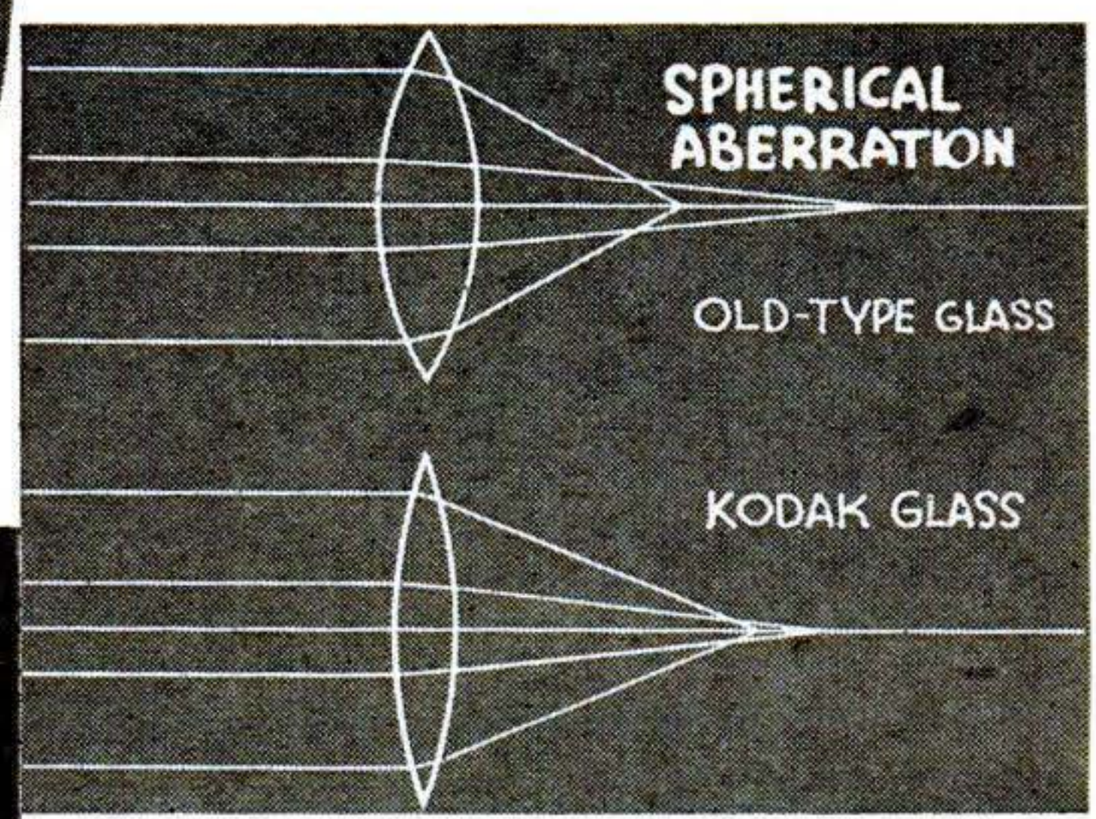
The Eastman achievement starts the optical industry afresh with a whole new line of glasses. Besides six kinds thus far announced, several others are coming. All of them are made from the oxides of lanthanum, tantalum, and tungsten in varying



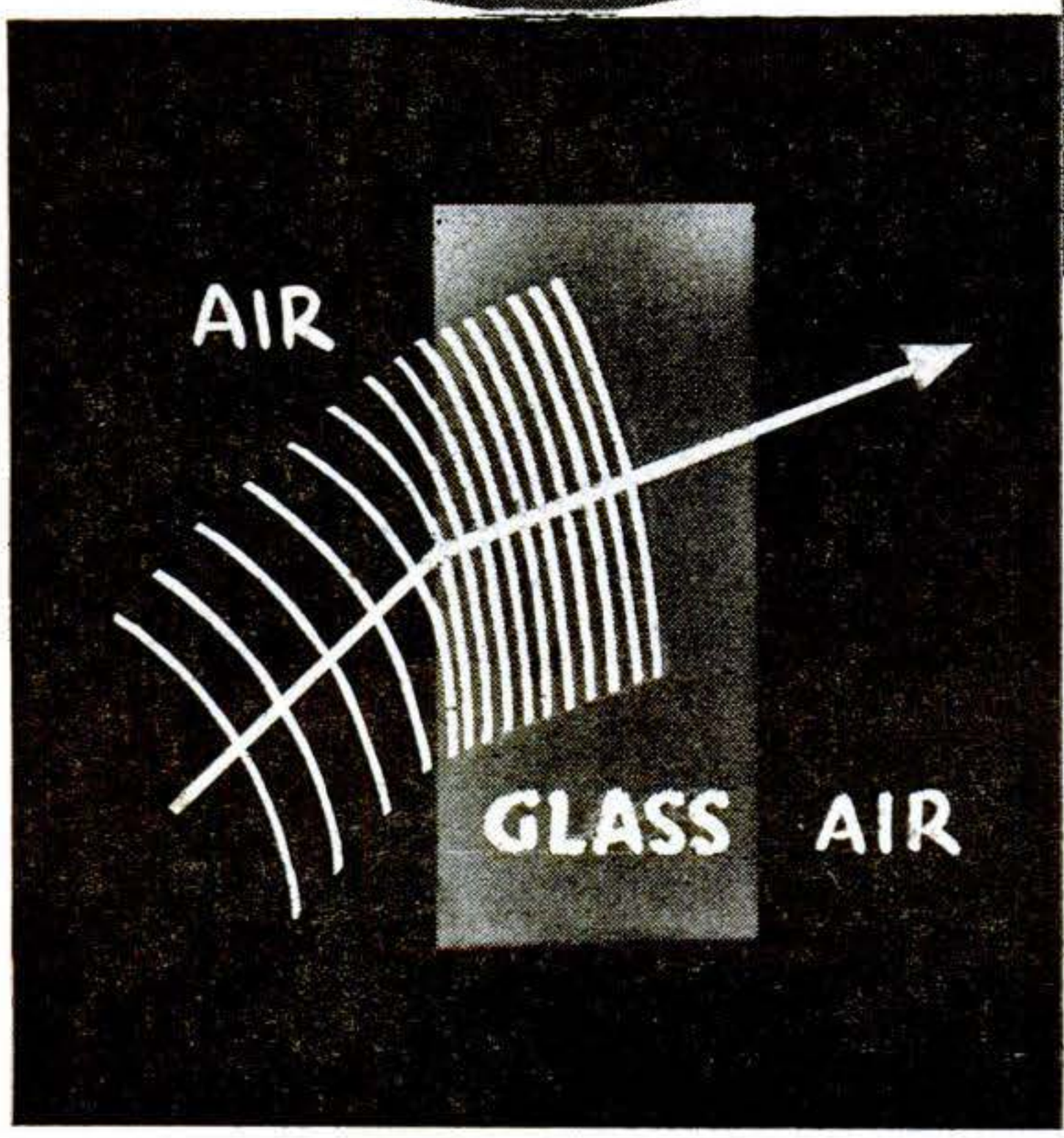
Because glass bends light, a ruler seen at an angle through two blocks of it appears broken. Kodak glass, bottom block, bends light more than the barium crown glass.



A light wave (left) is slowed up when it passes from air into glass, which is denser, but regains its usual speed upon re-entering the atmosphere.



Lens of old-type glass has greater curvature (top) for equal refractive power of new glass (bottom). Greater curvature causes spherical aberration because rays passing through near edges are bent at sharper angle and focus, or converge, nearer lens than rays passing near the center.



When light enters glass at an angle, or strikes a lens's curving surface, one edge of each wave is slowed down ahead of the other. The entire wave is deflected down and continues in that direction until it emerges.

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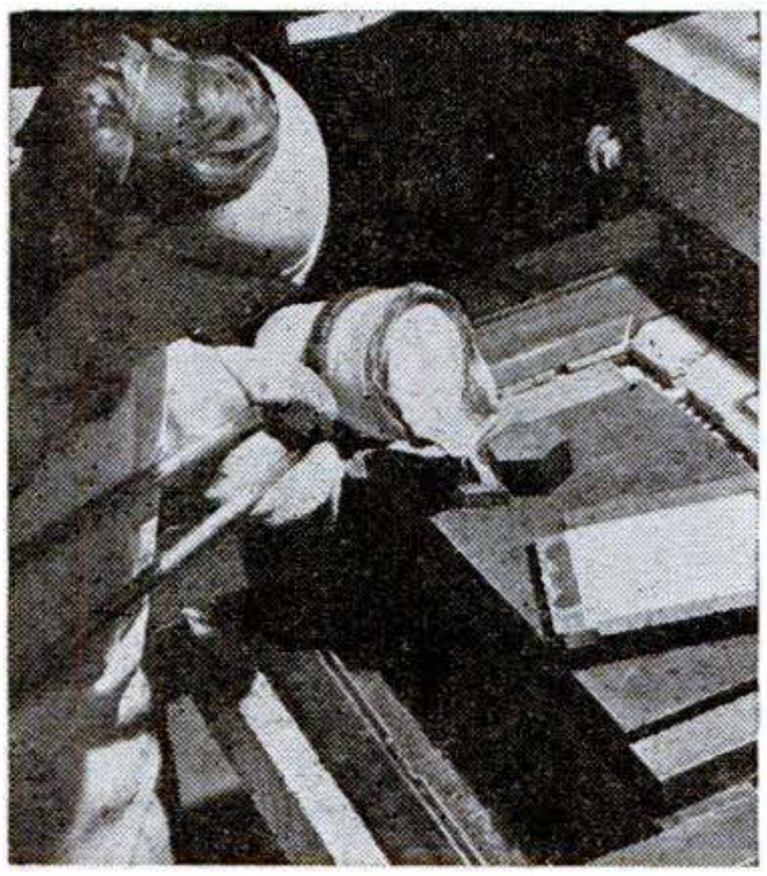
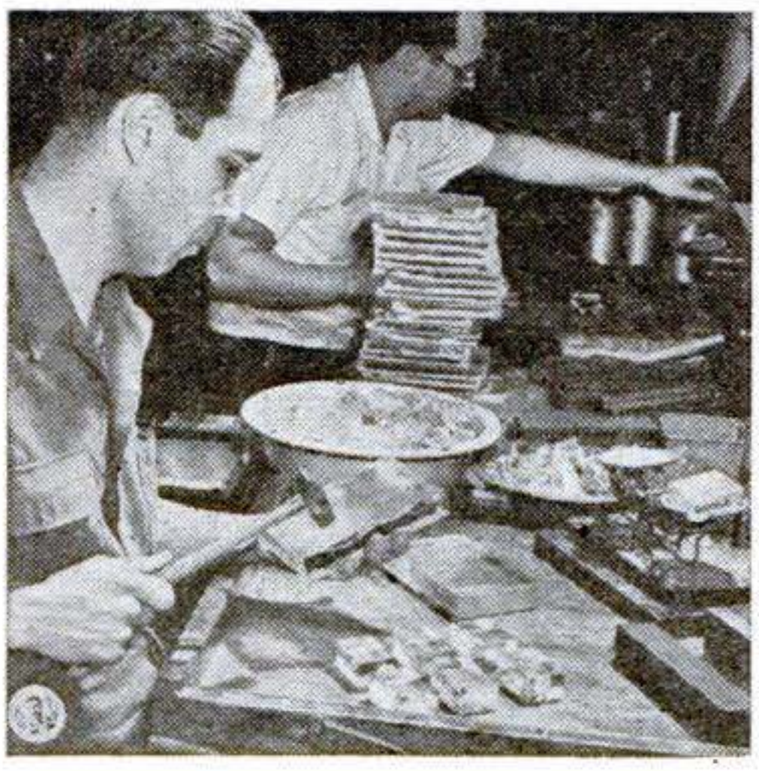


The making of Kodak optical glass begins with weighing rare oxides (at left, above) for platinum crucible, $4,000 liner of which is shown in center. At right, above: Ingredients are poured into preheated crucible.

After being melted in electric furnace, the new glass is cast in slabs and test-sample prisms (at left). Slabs, edge-lighted, are inspected forimperfections(right).



Slabs of the Kodak glass are cut into rectangles of desired sizes by being scribed, then tapped with hammer (left). Sample prism from each melt is then placed in apparatus that measures its refractive index and light-dispersion property with great exactitude.

proportions. The only common ingredients used are boric acid and barium oxide.

The new glass was the work of years. To obtain raw materials in a pure enough form for making optical glass was a problem. Even the purest at first available were contaminated with many undesirable chemicals. For example, 50 parts per million of iron oxide were common in some, but for water-white glass this had to be reduced to more than two parts per million. A year was spent working out purification methods.

Melting the new mix also presented a problem. It could not be done in any type of ceramic pot--the pot itself would dissolve first. A crucible of pure platinum was the answer. Each of these crucibles holds 10 pounds and costs about $4,000.

The rare-earth elements are far more costly than the ingredients used in even the best of optical glass formerly. The old ingredients were sand, which costs about a cent a pound, and barium, which costs about 50 cents. Against this, tantalum runs about $20 a pound, and the other ingredients are almost as costly.

Lenses made of Kodak glass are not correspondingly expensive, and the improved material means better lenses to broaden the scope of photography, and to increase the efficiency of telescopes, microscopes and other scientific instruments.

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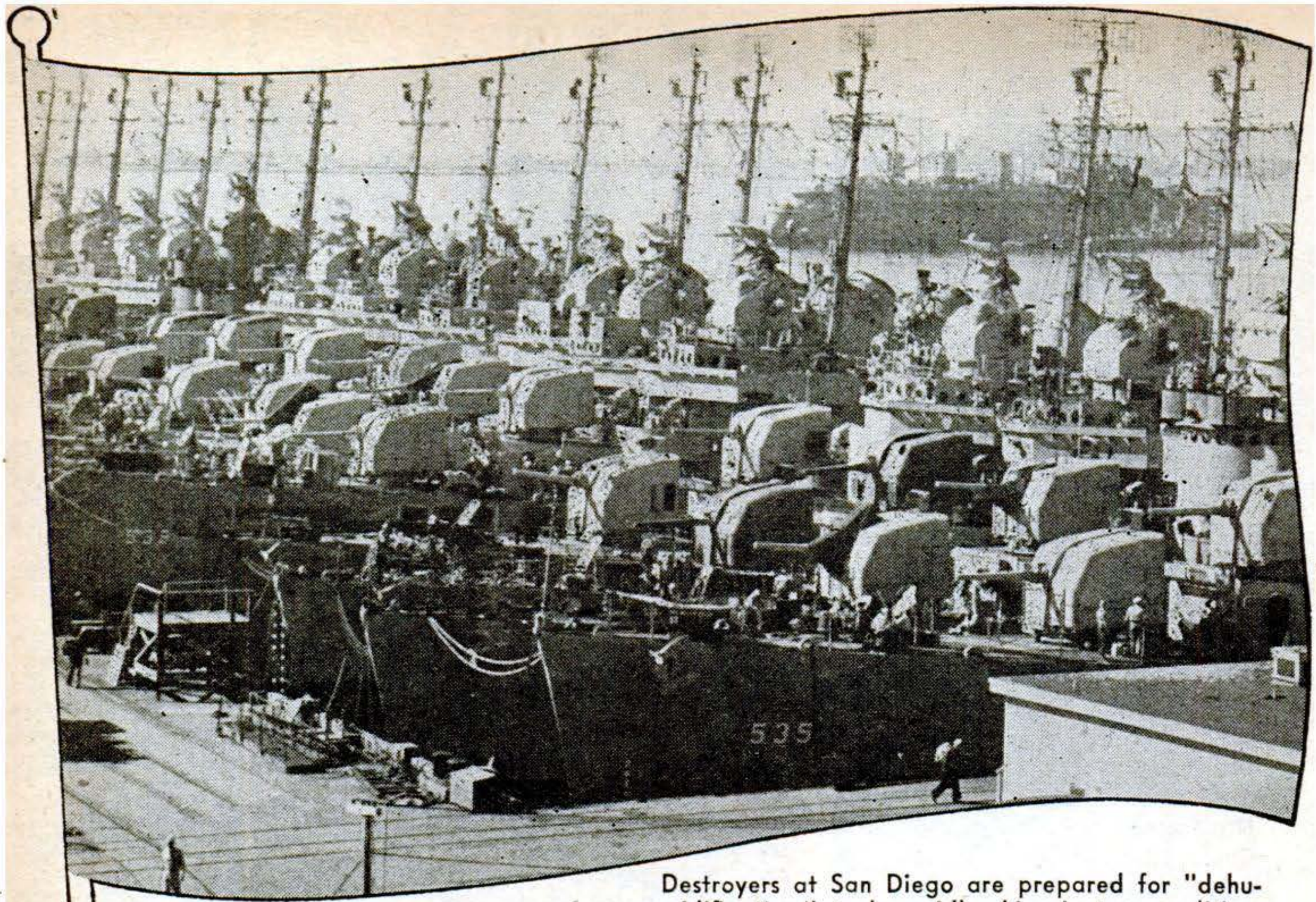


Destroyers at San Diego are prepared for "dehumidification," to keep idle ships in top condition.

SHIPS *in moth balls*

GONE for good are the Navy's famed "Red Lead Rows," where the ships taken out of service after World War I floated idly until they were recalled to duty. Replacing them are sleek, light-gray vessels now lined up in ports on both the Pacific and Atlantic coasts.

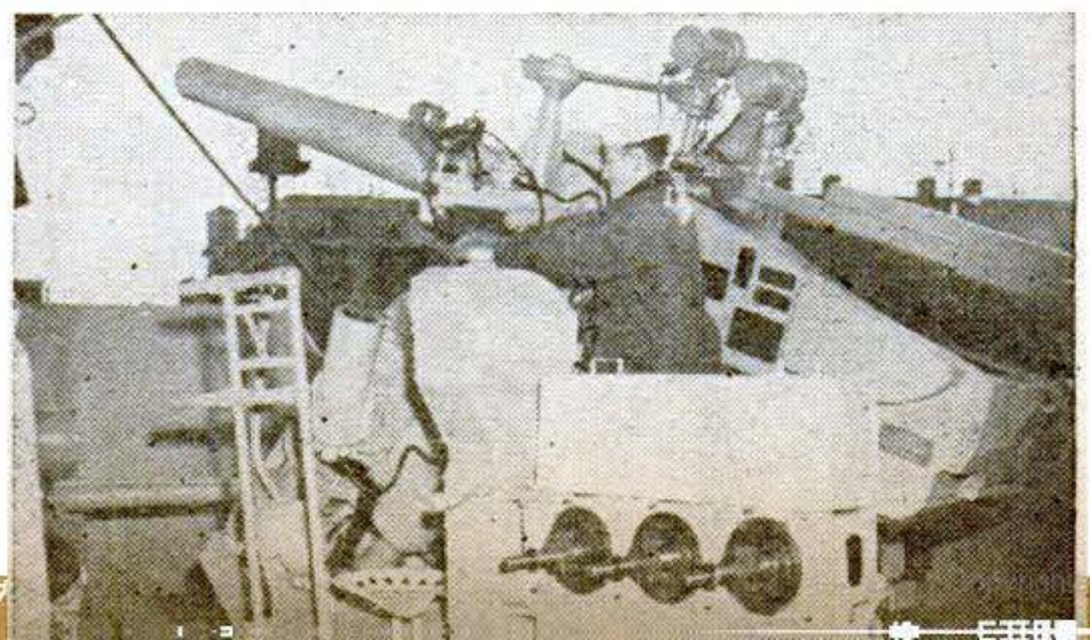
Superficially, the change from red to gray appears to be the chief difference between the reserve ships of the two wars, but, actually, the vessels of today will be able to sail in a fraction of the time it took to service World War I ships. The Navy has perfected a process of dehumidification by which 2,080 ships, 400 of them combat vessels and the remainder auxiliary and other craft—in all, one fifth of the Navy's wartime strength—will be maintained in inactive status. Yet, the craft can be put to sea in 10 days in any emergency.

Moisture, cause of corrosion, is the worst foe of inactive equipment, and the higher the humidity, the faster the corrosion. In the old "Red Lead Rows," parts were packed in heavy grease, especially those of ordnance equipment. This protected them, but it also concealed the pieces so that their true condition was not apparent until the coating had been removed. The thick grease had to be cleaned off before the equipment could be used. Dehumidification will eliminate most of this.

Dehumidification work on the reserve fleet is handled in two divisions. One involves the sealing up and drying out of the ship's compartments and turrets. The second includes the covering and sealing of

Below decks, a machine like this will keep the atmosphere dry to prevent corrosion and mildew.

On deck, all exposed equipment is stripped down, then bound with tape to hold a rubberlike casing.



equipment on the weather deck and in other exposed areas.

In preparation for dehumidifying the compartments, all vents are calked and covered with plates that are tack-welded so that they may be removed easily. Hatches are specially lined to protect their rubber gaskets. Even the smokestacks are sealed. In some cases, where compartments are divided, pipe lines are installed to provide a continuous flow of air throughout the enclosed portions of the ship.

Large-caliber guns, which have turrets, usually are connected with the compartments so as to keep dry at all times the air circulating over their working parts.

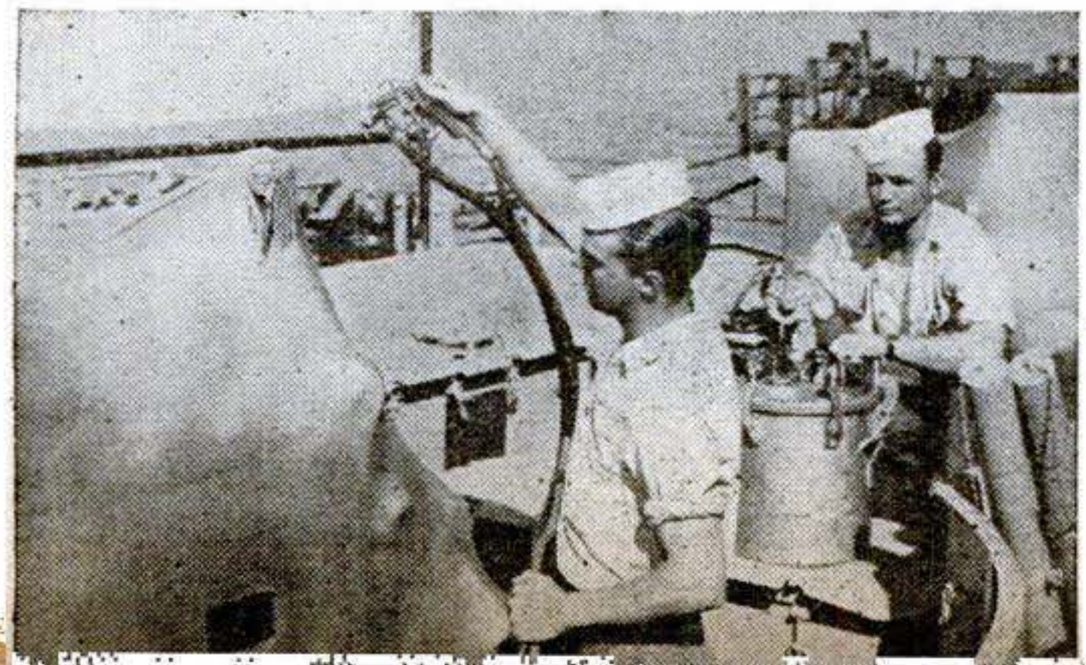
A dehumidification machine, which has large, twin-cone filters, is installed, and the air is circulated through the filters to keep the interior atmosphere of the ship within a humidity range of 25 to 30 percent. (A range of 50 to 70 percent humidity is considered desirable for ordinary air conditioning of a home or theater.) The filters, made of copper, are about four feet high and two feet in diameter. This dehumidifying gear is installed as permanent equipment on the ship as long as it remains in the inactive fleet. Cost of operation is estimated at only a few cents a day.

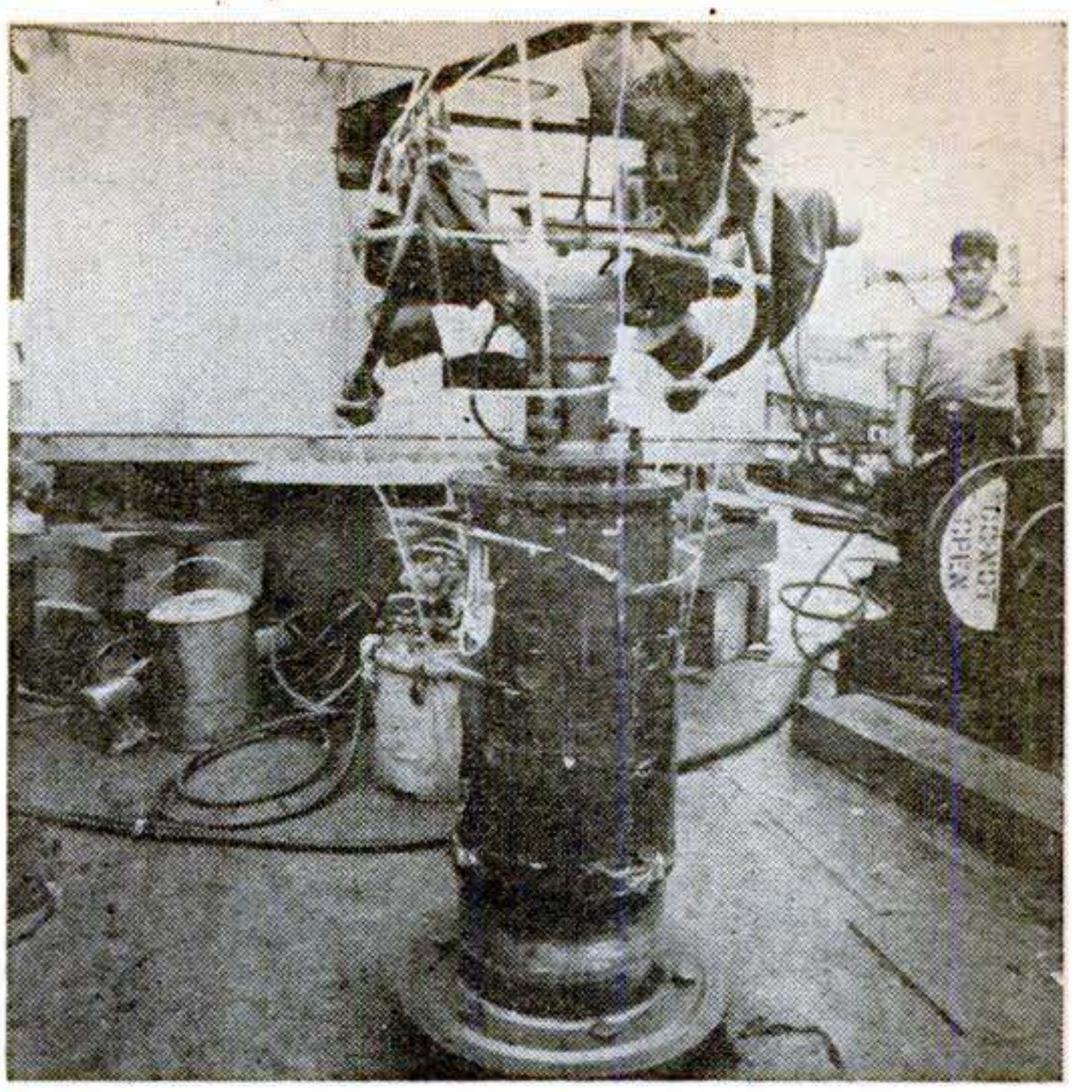
To cover the open-type guns and other exposed equipment on the weather deck, the Navy has perfected moisture-tight coverings made of strippable film, a rubberlike plastic. This protection against the ravages of rust and moisture (see photographs at right and below) can be ripped off in a matter of minutes, and the equipment will be found ready for action.

Inside the tough, opaque covering is placed a dehumidifying agent, such as silica gel, to insure continued low humidity. Through a window cut in the casing and then sealed, maintenance men can keep a constant check on an instrument inside that registers the humidity.

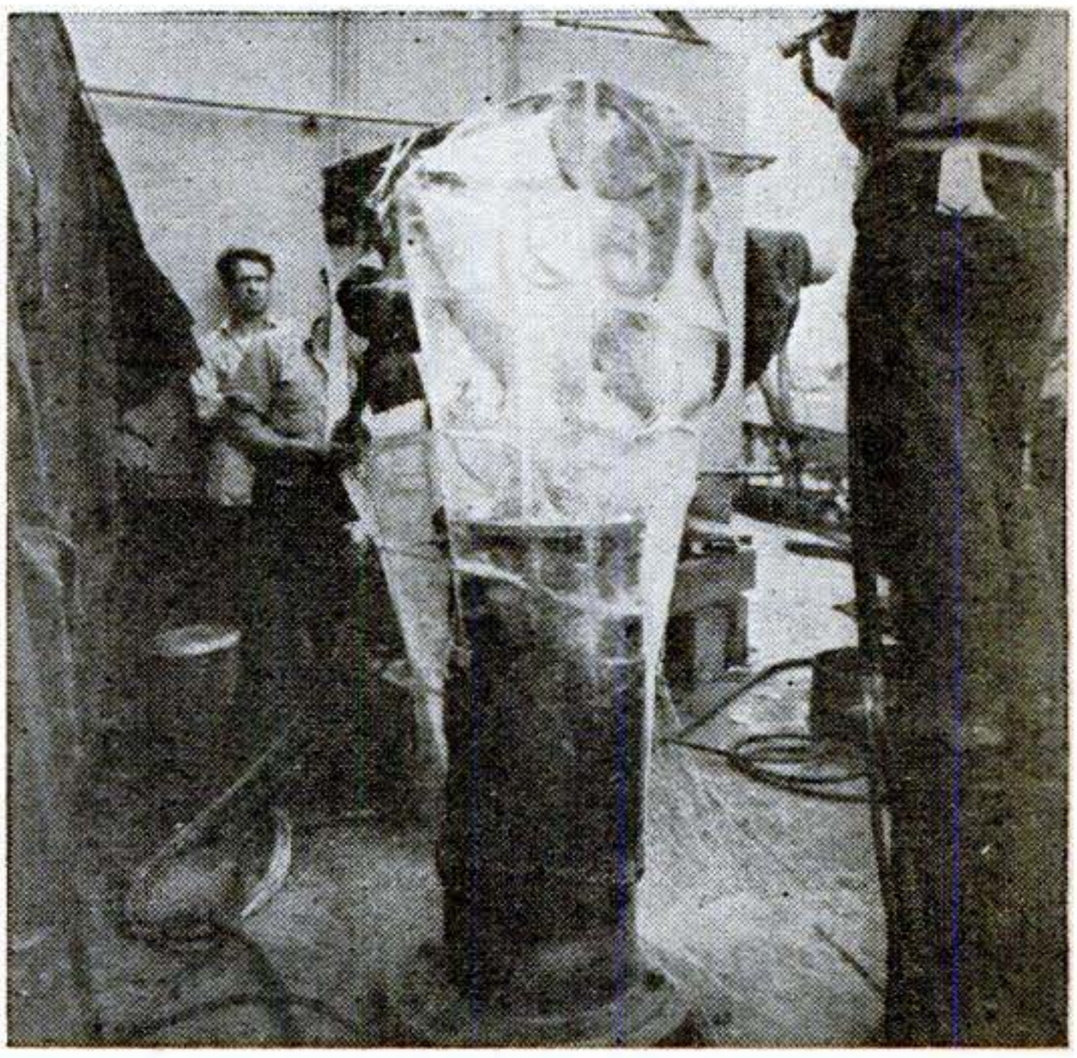
The Navy Bureau of Ordnance later may cover exposed antiaircraft guns with prefabricated sheet-metal protective structures much like the "cans" the Army uses to hermetically seal its big weapons in storage (PSM, Oct. '45, p. 78).

Over this casing is sprayed a hot plastic paint. Inside humidity is checked through the tiny window.

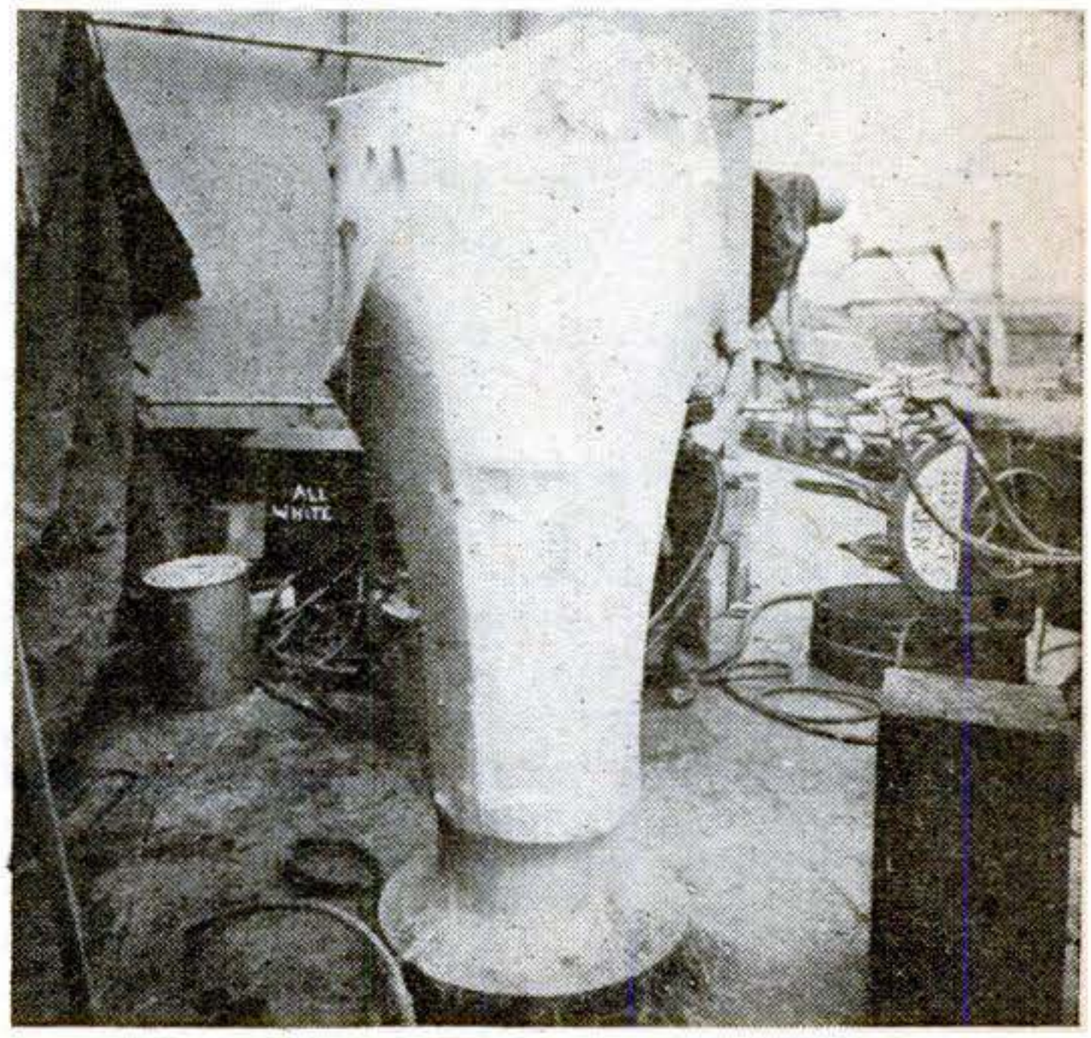




Scotch tape forms a lattice-work support for a plastic hood that will protect this gun director.



"Wrapping up" begins as liquid plastic takes hold on the tape. Damaging moisture cannot get in.



Completely packaged and protected from all weather. Tough cover can be quickly stripped off.

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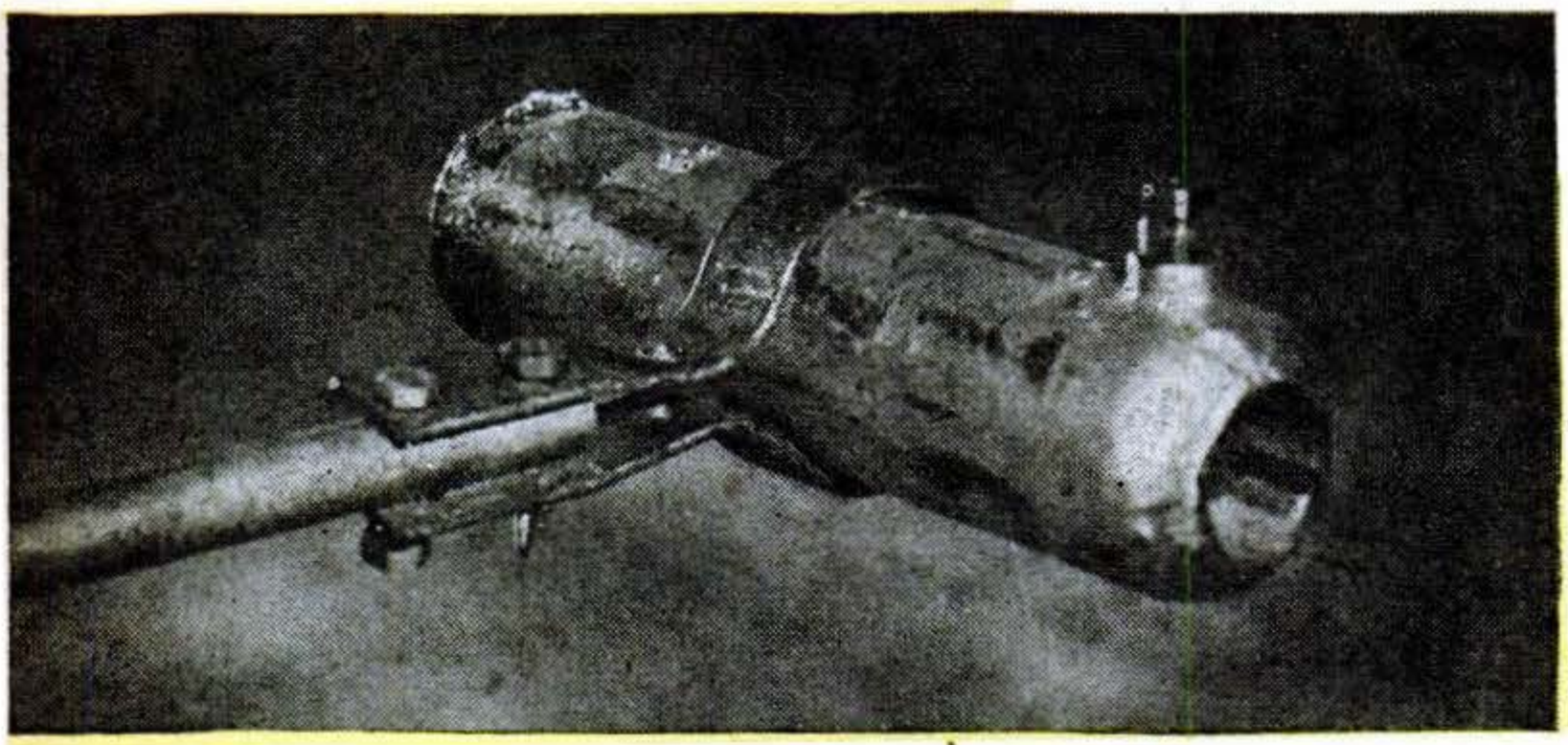
Simplest Jet Works

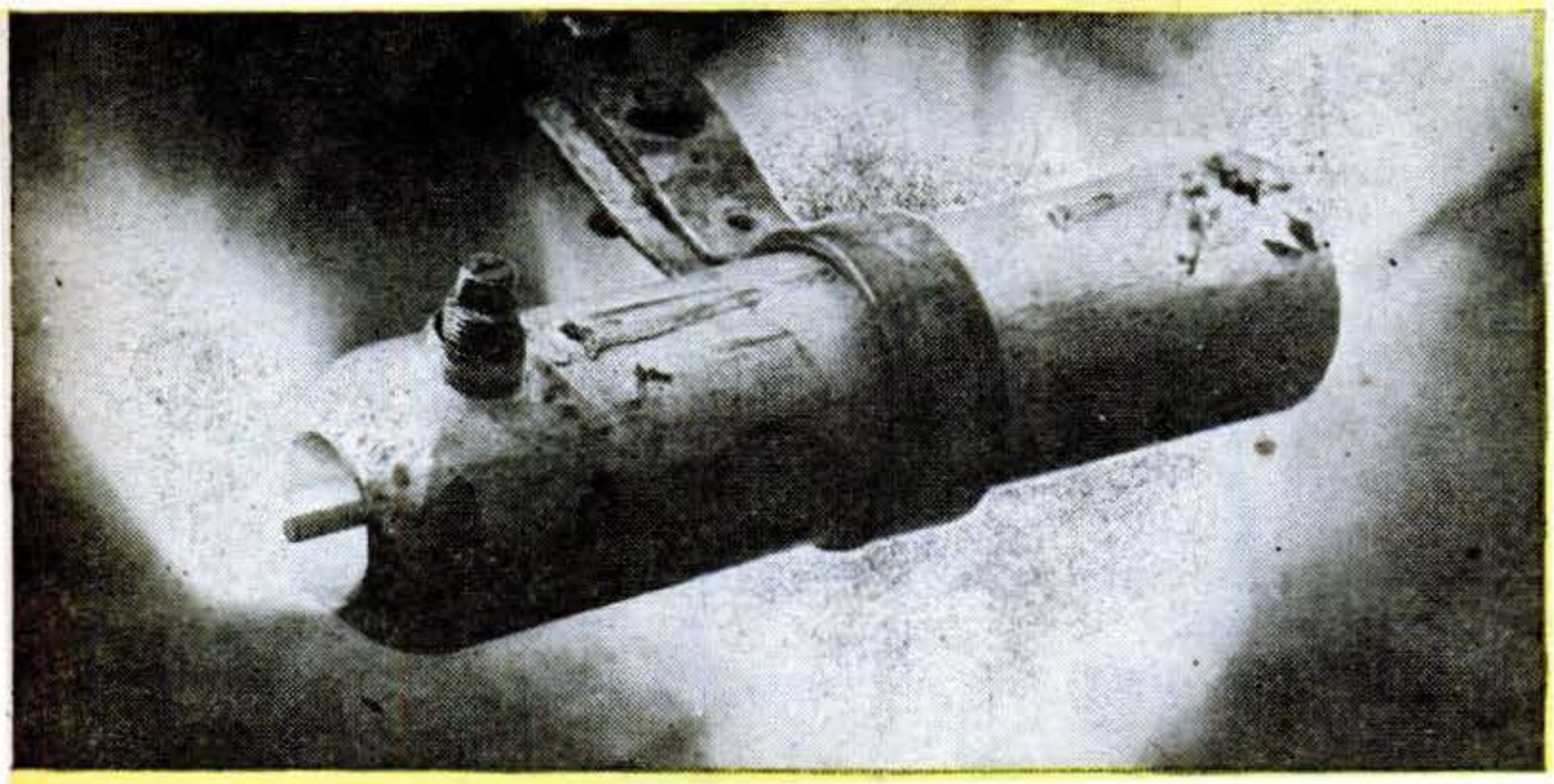
THE simplest power plant ever built, basically nothing more than a blowtorch, has been invented by the Polish rocket expert, Zygmunt Fonberg (left-hand figure in the accompanying photograph)—and it works.

Photos by W. W. MORRIS



1

The nine-inch athodyd reaction engine is fueled with alcohol through the plug in the top of its hollow jacket. Stem of burner jet protrudes from the front opening, one inch in diameter.

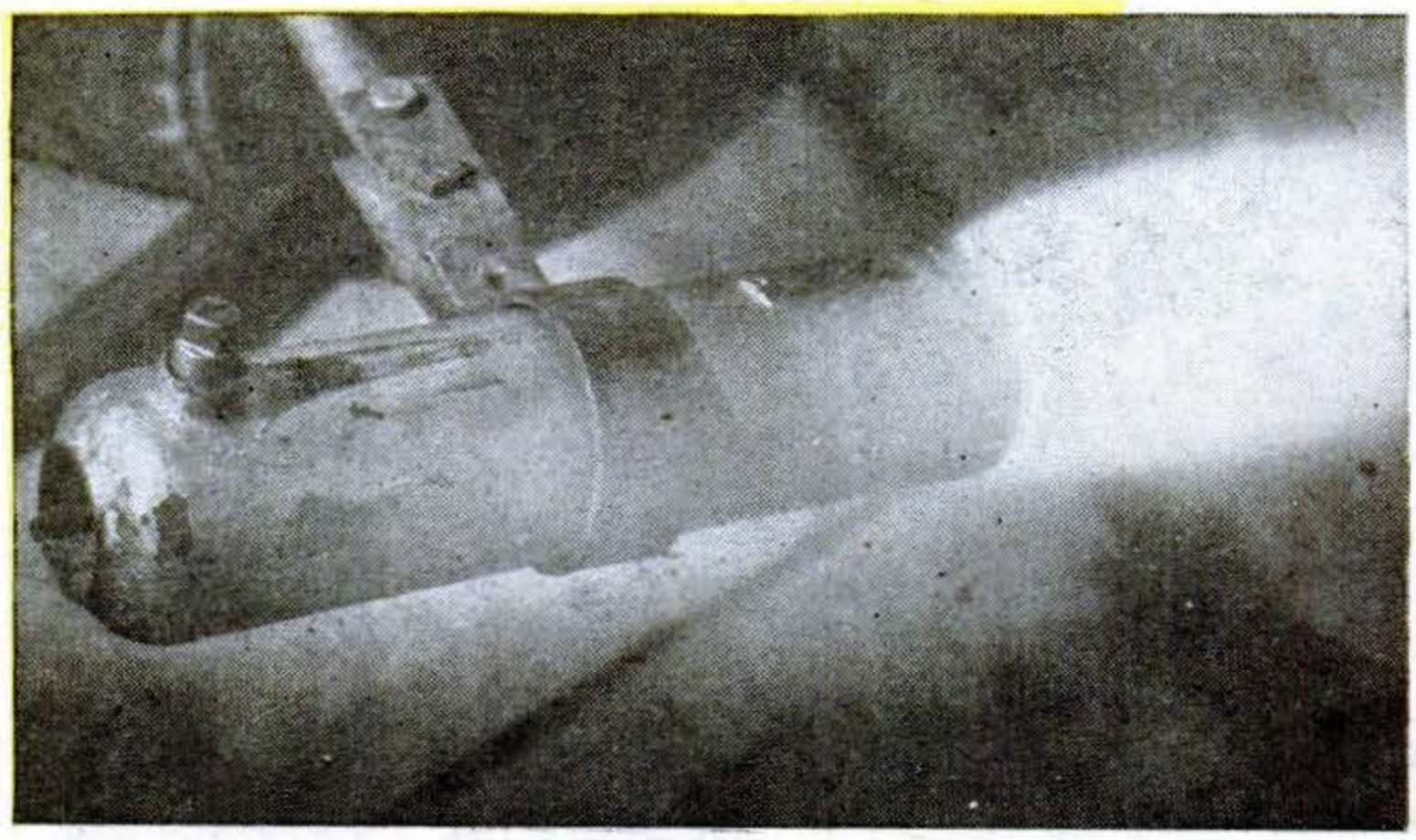


2

Alcohol-soaked cotton has been inserted in the small end of the cone and ignited, causing the fuel in the jacket to boil and sending vapor, which also is ignited, out rear end of cone.

3

As burning vapor flares from the rear and wider end of the cone, four inches in diameter, the bit of flaming cotton that started the engine is removed and air is drawn in the front end of the cone. This flow increases until a true jet flame comes roaring out the rear.



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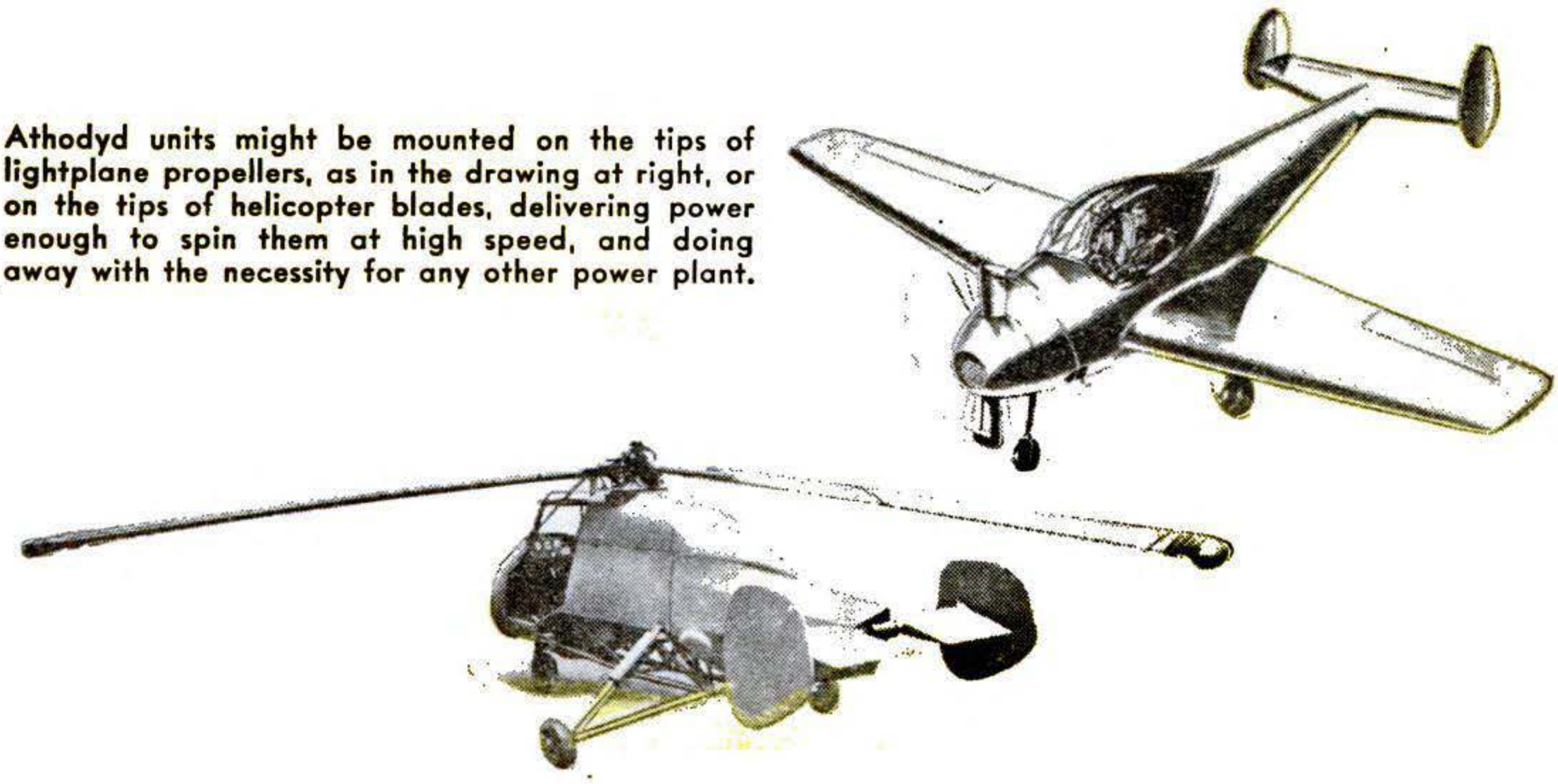
Athodyd units might be mounted on the tips of lightplane propellers, as in the drawing at right, or on the tips of helicopter blades, delivering power enough to spin them at high speed, and doing away with the necessity for any other power plant.



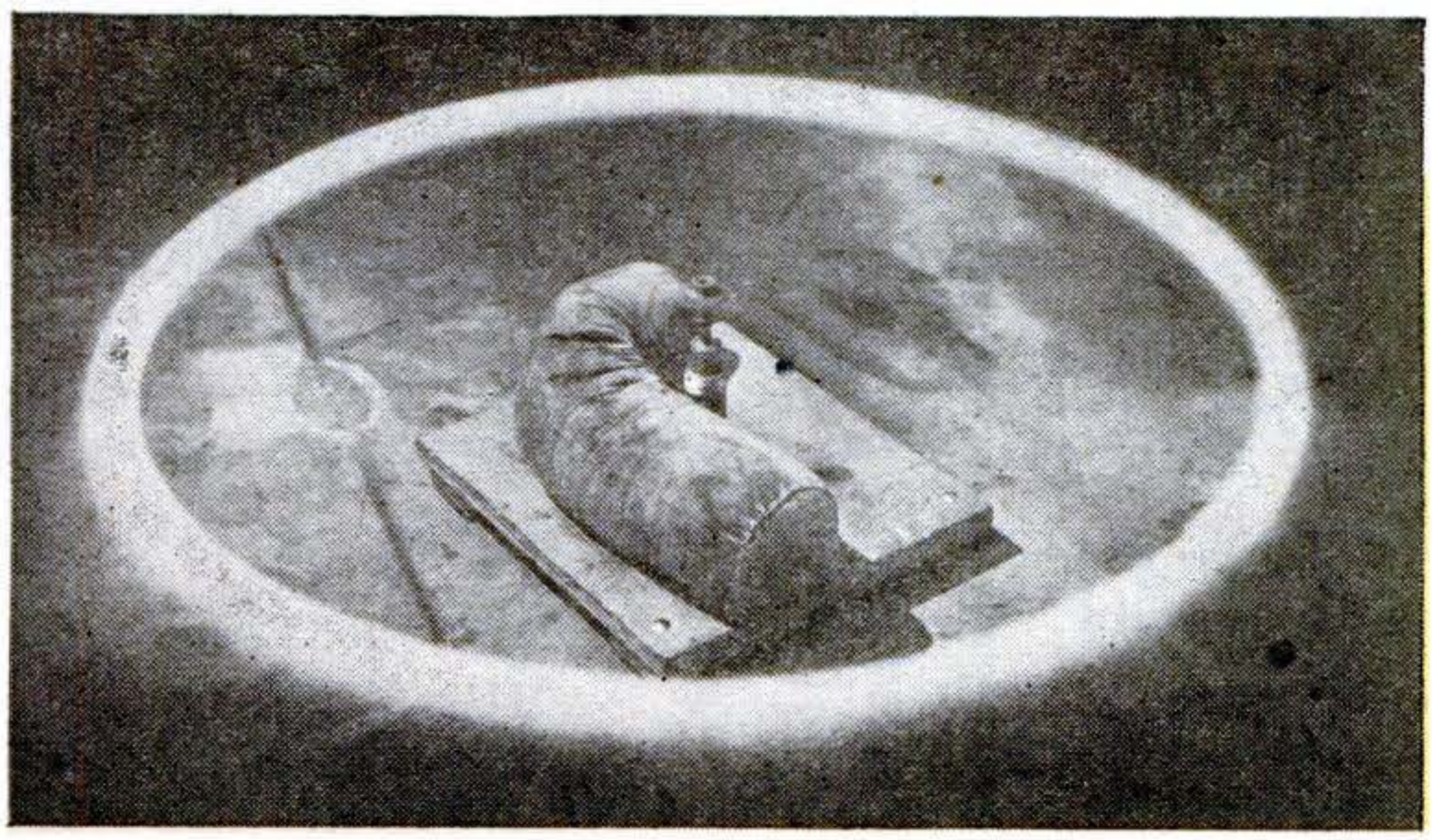
This elementary reaction engine is called an athodyd—a contraction of **a**ero**th**erm**ody**namical-**d**uct. It consists of a divergent duct within a hollow, streamlined fuel jacket fitted with an injector burner.

The original idea for the athodyd was suggested in 1913 by a French engineer, Lorin, who proposed a simple barrel-like unit without ends, into which fuel was introduced through a ring of jet nozzles within and ignited. This device was not actually tested until December 1944, when Lorin's ideas were translated into a model and tried out in the General Electric wind tunnel at Lynn, Mass. Here it was found that the engine would develop a speed of more than 300 miles an hour, *provided* it was started at about 290 miles an hour. That made the unit of dubious value at the current stage of development.

Now comes the athodyd that disproves the rule. This rugged individualist of the reaction-jet family is at present a crude, welded model of things to come. But it knocks into a cocked hat the statement: "a compressorless jet, like the athodyd, is not self-starting." This athodyd not only starts from a standstill but does it any number of times under any known conditions.

The model is a nine-inch engine only four inches in diameter, mounted on a five-foot length of gas pipe and counterbalanced by a section of pipe joint. Nevertheless, it develops a speed of about 60 miles an hour and requires a 75-pound sandbag to hold its mount stationary while it is whirling.

Fonberg, the inventor, and Benjamin Shupack, his associate in the development of this athodyd, say that the engine is a potential power plant for aircraft. It is jet power in its simplest form, as the numbered photographs demonstrate; easy to build, safe to run, economical and simple to operate. But it needs considerable development before becoming a practical, usable power plant. Although purely experimental at present, the Fonberg athodyd is another step toward the perfect aircraft engine of tomorrow.



4

A fiery ring marks the path of the athodyd as it whirls at top speed on the end of the five-foot pipe to which it is clamped. The push of the jet through the rear of the cone hurls the unit forward until its thrust is equaled by air resistance.

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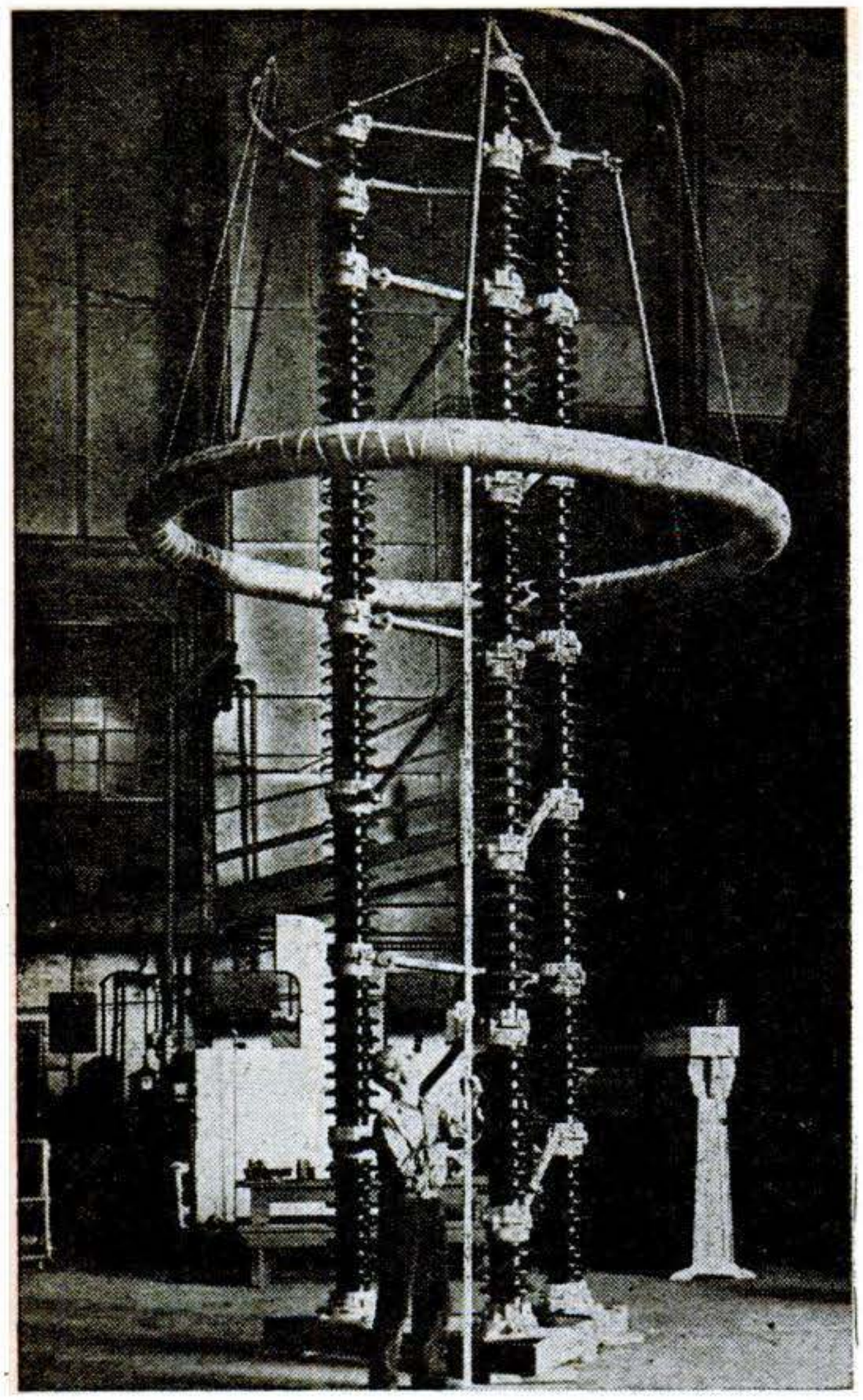

Lines Carrying 500,000 Volts Will Test Power Transmission

Two transmission lines, each a mile and a half long and capable of carrying 500,000 volts, will be constructed near Brilliant, Ohio, for tests next summer of the feasibility of transmitting electric power longer distances at greater voltages than ever were attempted before. A 287,000-volt line, the highest now in use, transmits power approximately 250 miles. Tests by the American Gas & Service Corp. will determine how much farther and at what cost electric power can be transmitted on 500,000-volt lines.

The Westinghouse Electric Corp. is building three single-phase, high-voltage transformers, each 37 feet high; huge lightning arresters of the same height, and intricate metering equipment for the experiment. The lightning arresters, one of which is shown above, will have special grading rings to equalize voltage stresses along lengthy "chains" of insulators. The metering equipment will measure line voltages and seepage of power and is expected to be the most accurate of its kind. It will be able to pass large currents but measure low power.

New Gunsight Projects Bull's-Eye

WHEN a hunter looks through the new Nydar sight for shotguns, made by the Swain Nelson Co., Glenview, Ill., he sees a bull's-eye pattern in the sky. He simply centers his target in the ring he sees.

Tide Predictor Goes to Russia

THE tide anywhere in the world on any date can be predicted by a rare $20,000 instrument, weighing a ton, which an English firm has built for the Soviets. Once controls are set according to variations in the attraction of sun and moon, and tide constants at a given port, the instrument gives its answer in an hour or two.

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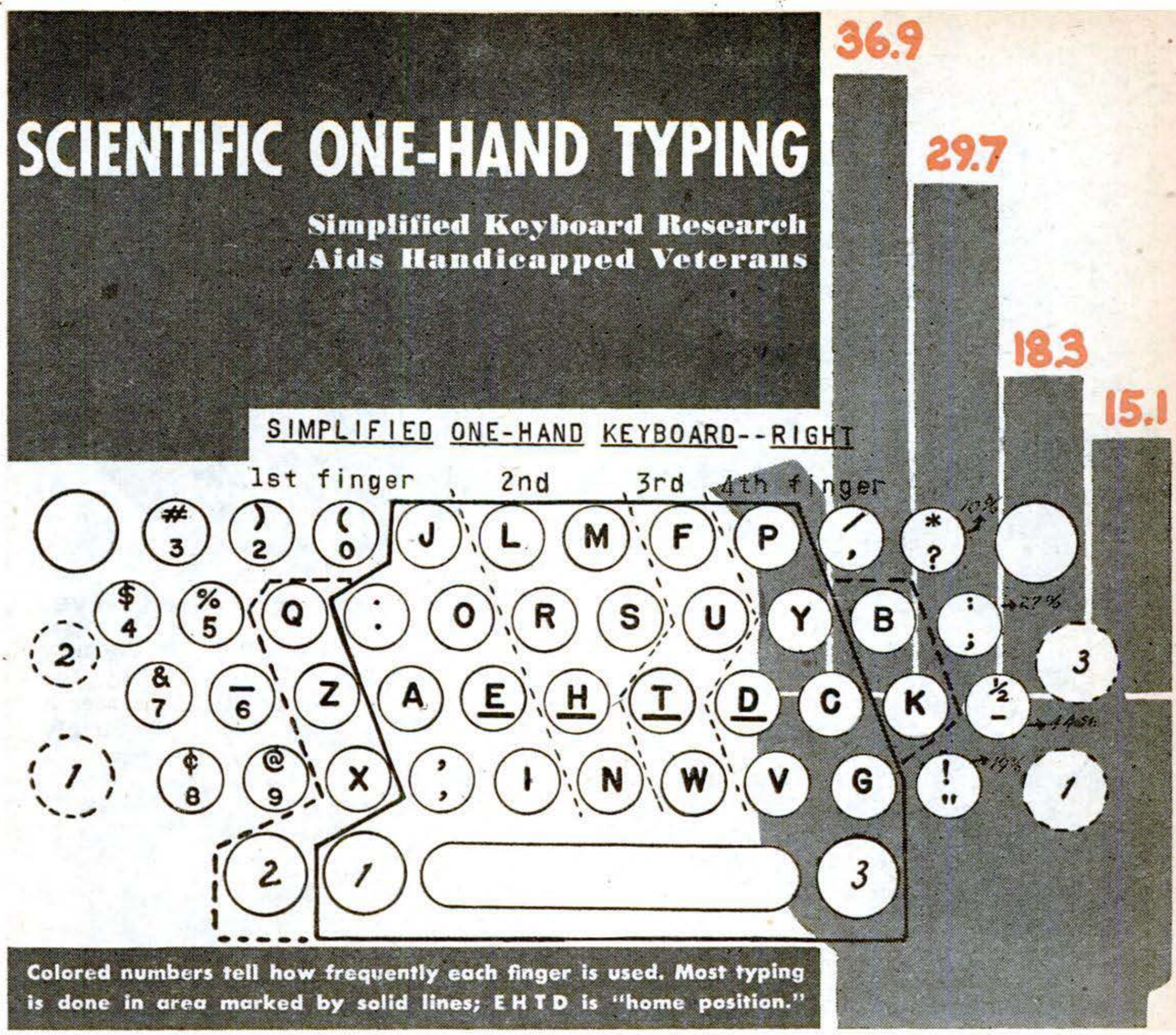
SCIENTIFIC ONE-HAND TYPING

Simplified Keyboard Research Aids Handicapped Veterans



Colored numbers tell how frequently each finger is used. Most typing is done in area marked by solid lines; E H T D is "home position."

By RICHARD B. LEWIS

Lt. Comdr., USNR

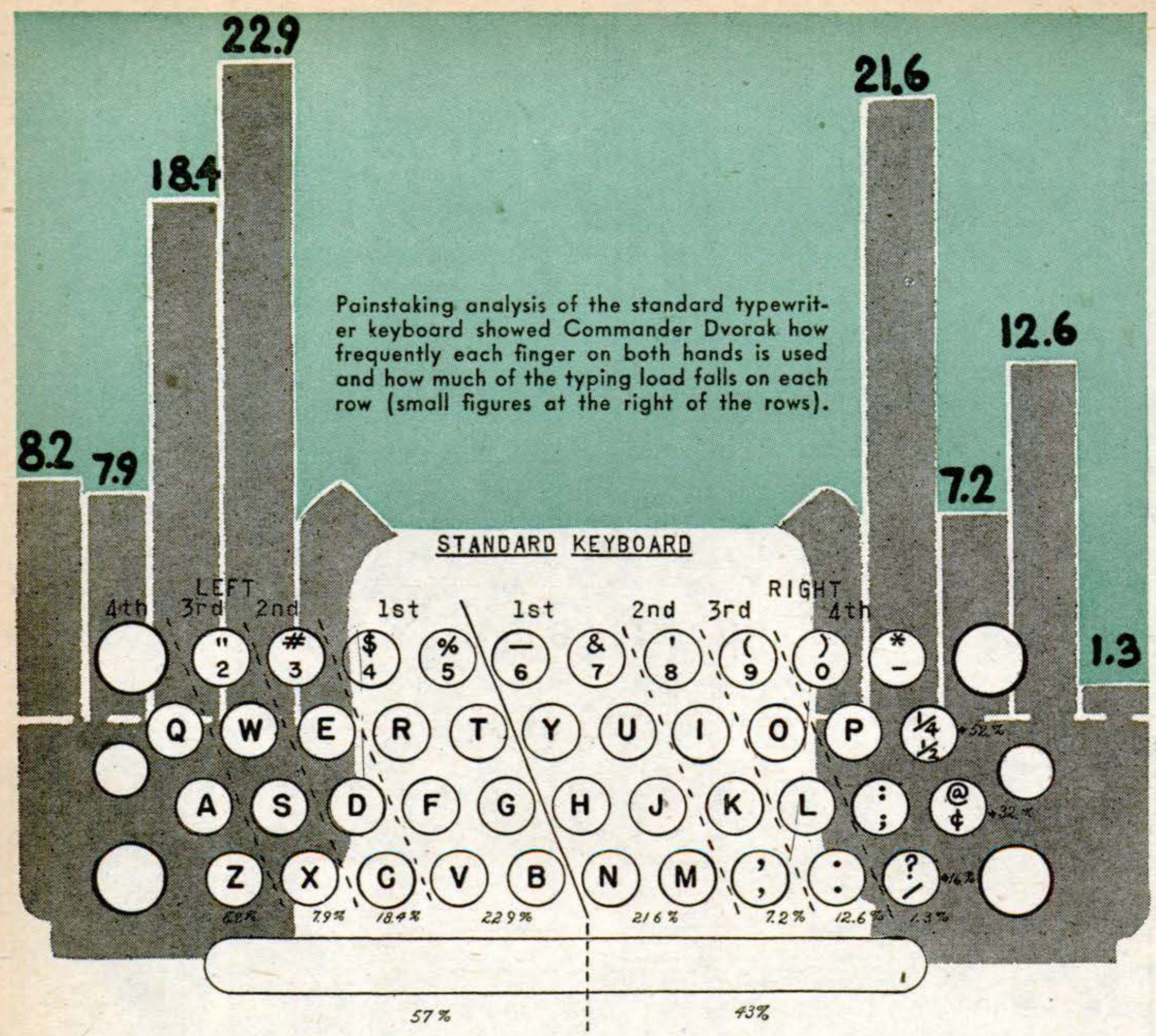
PEOPLE who have lost the use of one hand can now learn to type with satisfactory speed and efficiency. For this they are indebted initially to Col. Robert S. Allen, prewar columnist-partner of Drew Pearson, who determined not to let the loss of an arm in battle stop him from resuming his career as a newspaperman. But the man to whom they owe the most is Commander August Dvorak, USNR.

Discouraged by his failure to master the standard typewriter with one hand, Colonel Allen turned to Commander Dvorak for help. In 10 years of exhaustive research in typing for the Carnegie Foundation for the Advancement of Teaching, Dvorak, then a professor at the University of Washington, and his associates had developed a simplified keyboard for two hands. Tests proved that normal typists could relearn to type on the simplified keyboard in 83 hours—and double speed records they had made on standard typewriters. Commander Dvorak believed a special keyboard might make similar gains possible for one-handed typists.

He used the same methods of study that had produced his original simplified keyboard: taking slow-motion pictures of finger action, analyzing the causes of typing errors, noting the frequency with which various letters and combinations of letters are used.

It was soon evident that, for a one-handed typist, the standard keyboard must be completely revised on the basis of letter frequency and normal reaches. Commander Dvorak also found that a keyboard for the right hand would differ from one for the left; so he developed two, one for each hand.

Hardly had the ink dried on Commander Dvorak's drawing of a typewriter keyboard for left hand than Colonel Allen had a machine converted to this new arrangement of characters. In four weeks he was typing at a rate of 25 words a minute, about as good as high school students average after a



year's instruction on standard typewriters, far better than any one-handed typist had been able to do on a standard keyboard.

There are still four rows of keys on the new keyboard, but the keys used in 99 percent of all ordinary typing are concentrated in the center. That is the secret of its success. Painstaking calculations have determined the frequency with which individual keys and sequences of letters are used in most writing. As a result, one finger seldom strikes several keys in succession and the fingers share the work in a natural order.

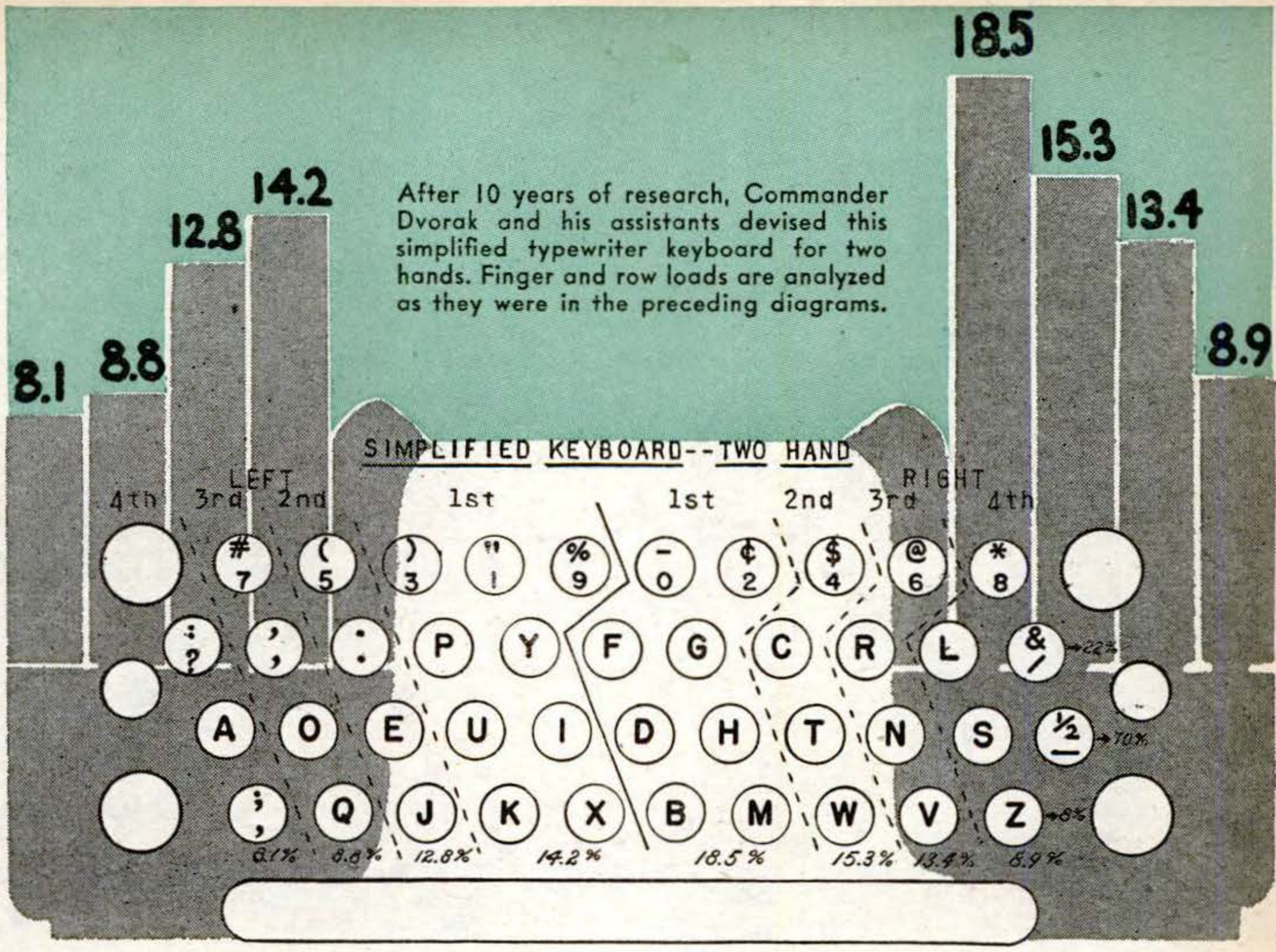
Any standard typewriter can be converted to the new keyboard for one hand, either right or left, and new typewriters, with the keyboards installed, can be obtained. The U. S. Navy has ordered some for the purpose of teaching typing at the Philadelphia Naval Hospital to amputees who are interested. If this program proves successful, a similar one will be established at all Naval Rehabilitation Centers.

Devices have been developed for both manually and electrically operated typewriters (see page 133) to make it easier for one-handed typists to operate the capital shift and lock on the new keyboards.

Exercises for practice have been prepared that enable a one-handed typist to type a limited number of words and sentences after the first 30 minutes of practice. After the typist has done the 24 key-position exercises, he knows the keyboard well enough to type effectively; from that point on, his speed depends on the extent of his practice.

If you want to see what it is like to use the new keyboard for one hand, write the following sentence on your standard typewriter with the right hand alone: "As we look at the one-hand typewriter our hopes increase." Now, rest the fingers of your right hand on G H J K; this is where the "home position," so necessary to touch typing, is located on the keyboard for right hand. Type this: "Fu mg 6tt; fj jhg tng hfnk jo9gmybjgy tiy ht9gu bnlygfugr"

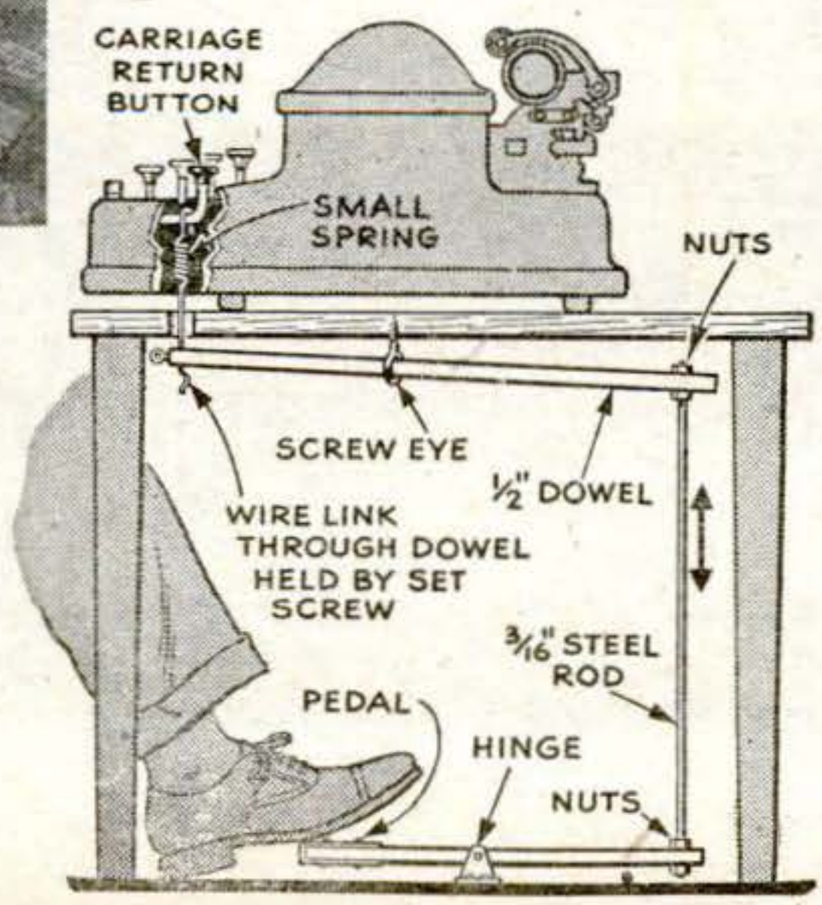
Although the writing makes no sense on your standard keyboard you have actually written the above sentence on the proper key positions of the new keyboard for right hand. See the difference?

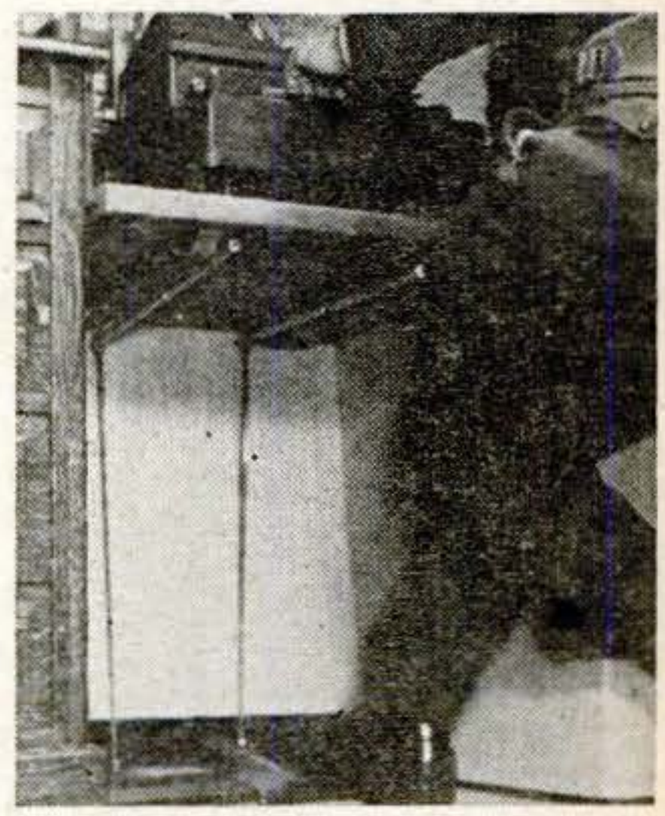


PEDALS SPEED ONE-HAND TYPING

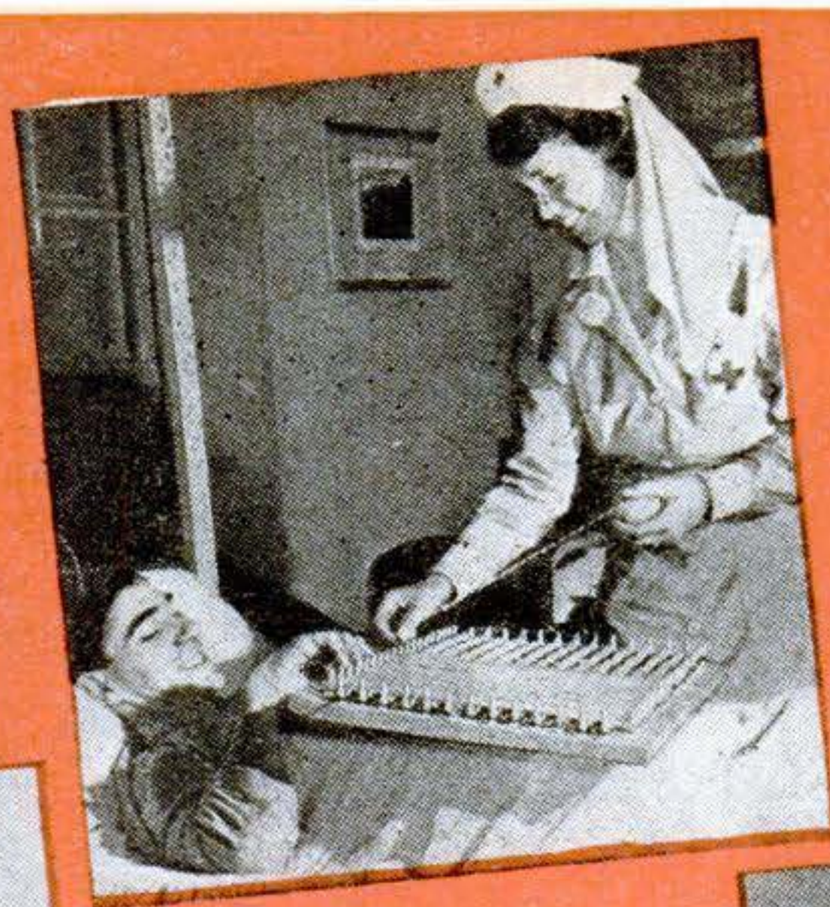
One foot works both pedals on the manual typewriter. Right-hand pedal, by a simple gear and pulley, operates carriage return. Left pedal, by string and spring, works shift key.

COMMANDER Lewis, author of the accompanying article, has constructed a simple apparatus to operate the carriage return and shift key on both manual (left) and electric typewriters (below and right).





By means of the efficient device diagrammed at left, two pedals operate the carriage return button and shift key on an electric typewriter. In this case, operator uses both feet.

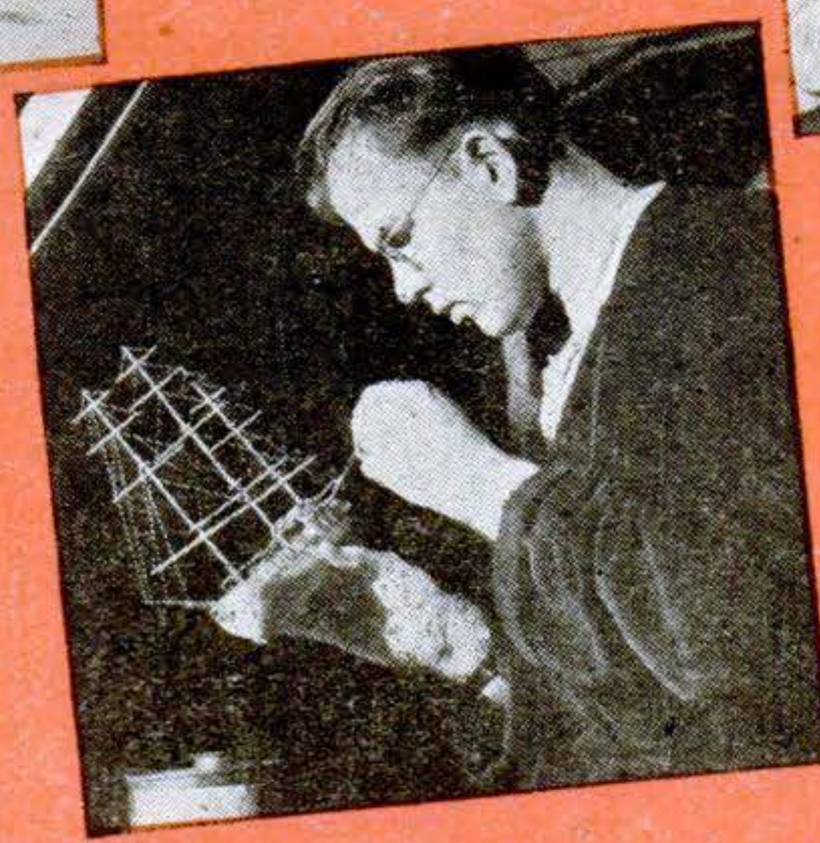


A Red Cross Gray Lady helps a soldier learn to use a small hand loom in a hospital.

The man in the picture below is putting the finishing touches on a model airplane he has made.

The Red Cross encourages skills of disabled GIs

Belt-weaving is an enterprise that hospitalized veterans take to with interest and skill.



At a hospital in England a serviceman from Michigan pursues his former hobby, ship-model craft.

Handicraft Contest SPURRED *by*

ENTRIES pouring in for the Popular Science Servicemen's Handicraft Contest from all over the world now indicate that the judges are going to have a hard job to pick the prize winners. The excellence of the craftwork is partly the result of the encouragement and instruction that servicemen have received from the Red Cross, which is now conducting its 1946 National Fund Campaign.

Many different kinds of handiwork have been produced by the men and women of the armed forces with the help of Red Cross staff and volunteer workers. Hospitalized soldiers in New Caledonia made bark and canvas into scrapbooks. A serviceman in the Russell Islands of the Solomon group carved a baton out of teakwood for a friend who led an orchestra. Then, in Kwajalein, a man from Texas started a fad by weaving a mat of raffia and painting a native scene on it in oils.

Soldiers in the hospitals of the Persian Gulf Command did not feel that they were sissies because they went in for needlework and embroidery. They kept their hands and minds busy; and the humor of the thing appealed to them. Battle-scarred infantrymen

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in southeastern Asia learned to improve their time during convalescence by making beads out of jungle seeds, weaving local grass and crude silk, tooling leather, and making jewelry.

Today as thousands of fighters are recuperating in hospitals, the Red Cross is leading the way for complete rehabilitation. Handicraft projects are helping, and it is PSM's purpose to encourage them. Entries for the Contest must be mailed or otherwise shipped not later than 6 p.m. on Monday, April 1; but to allow for transit from remote places, the deadline for the receipt of entries will be 6 p.m., April 30.

Then the judges will get busy: Frances Langford, favorite entertainer of many thousands of servicemen and women; Brig. Gen. Georges F. Doriot, Rear Adm. Harold B. Miller, Sgt. Merle D. Miller, Maj. Walter W. Hitesman, Jr.; Maj. Nathaniel Saltonstall, chief of the Handicraft Branch of Army Service Forces; and Mrs. Cass Canfield, a famed sculptress, former national director of the Arts and Skills Corps of the American Red Cross, and now adviser to the Corps in the North Atlantic Area.

The pictures reproduced on these two pages were taken by the Red Cross in hospitals both in this country and overseas. The activities they show are only a small part of those aided by the agencies at work in this field.

- (Top) A patient begins making a billfold with help of Red Cross.
- Skillful direction (center) helps disabled soldiers in using hands.
- The merchant seaman (right) is staining a belt job he has done.

The GI (left) plans a fishing trip as he ties flies.

Red Cross

Guadalcanal and Kwajalein yielded shells for necklaces.

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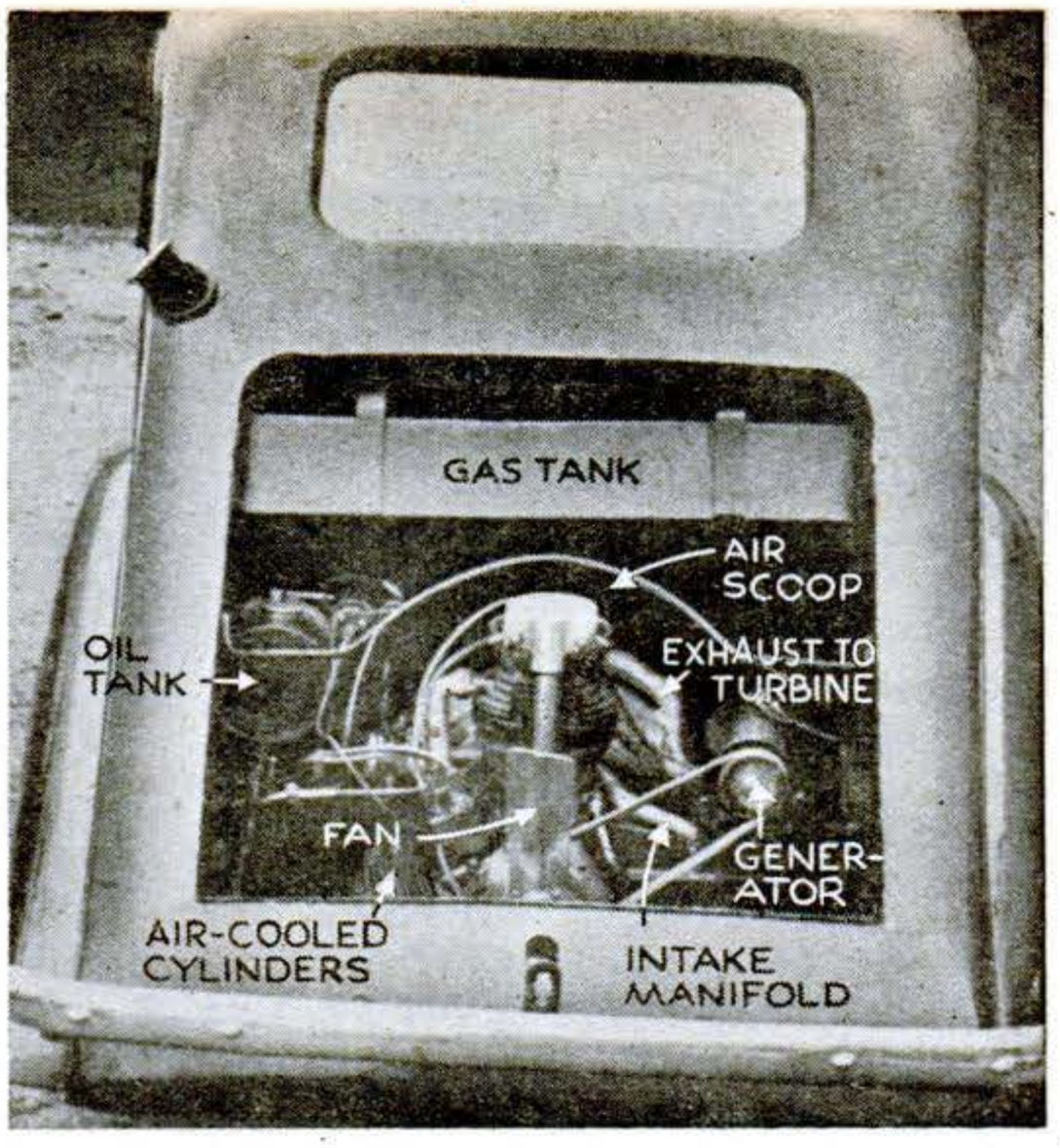
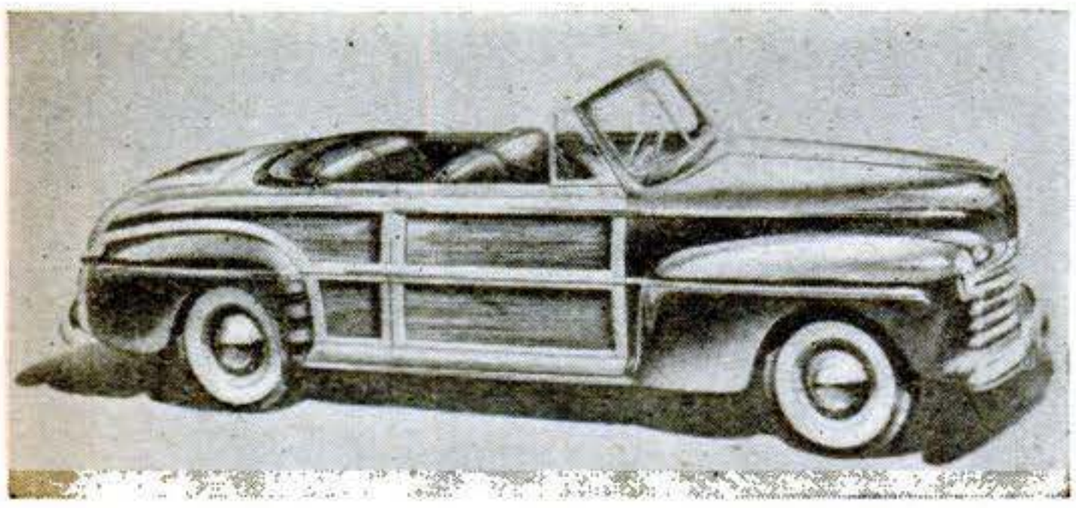
AUTO IDEAS



ENGLISH MOTORISTS soon may be able to buy a light car for only $400. William Denis Kendall, who designed the four-passenger model above, says he will employ mass-production methods at his factory in Grantham, England, to keep the price within that figure. In tests, the three-cylinder radial air-cooled engine developed 20 hp., propelled the car at a maximum speed of 60 m.p.h., and gave 40 miles to a gallon of gasoline. The designer claims that power is increased through a "turbine" method of bringing the heat and pressure of the exhaust gas into play. Built with no frills, not even an extra wheel, the car weighs approximately 1,200 lb. A roomy luggage compartment is located under the hood and a single headlight is centered in a dummy radiator.



STATION WAGON and convertible both contribute some of their features to a sport-type car, shown at the left, which the Ford Motor Company has announced for limited production this year. Traditional wooden panels of the station wagon are applied over a steel frame, while a power-operated top and close-coupled seating are borrowed from the convertible coupe.

SPORT CYCLE. A small power cycle developed by the Wyse Laboratories, of Dayton, Ohio, is equipped with a centrifugal hydraulic transmission that eliminates gear shifting. Given the trade name of "Wyse Cycle," the 245-lb. vehicle might be considered a cross between a motorcycle and a scooter, for it has some characteristics of each. In the photo at the right, the smiling miss is seated on a test model which differs in several respects from the designer's original conception shown in the inset. In tests, the cycle traveled at speeds up to 56 m.p.h. and gasoline consumption averaged 70 miles per gallon. Now in production, the cycle may be obtained with either a 3- or a 4-hp. engine. Aircraft-type wheels and tires are used.

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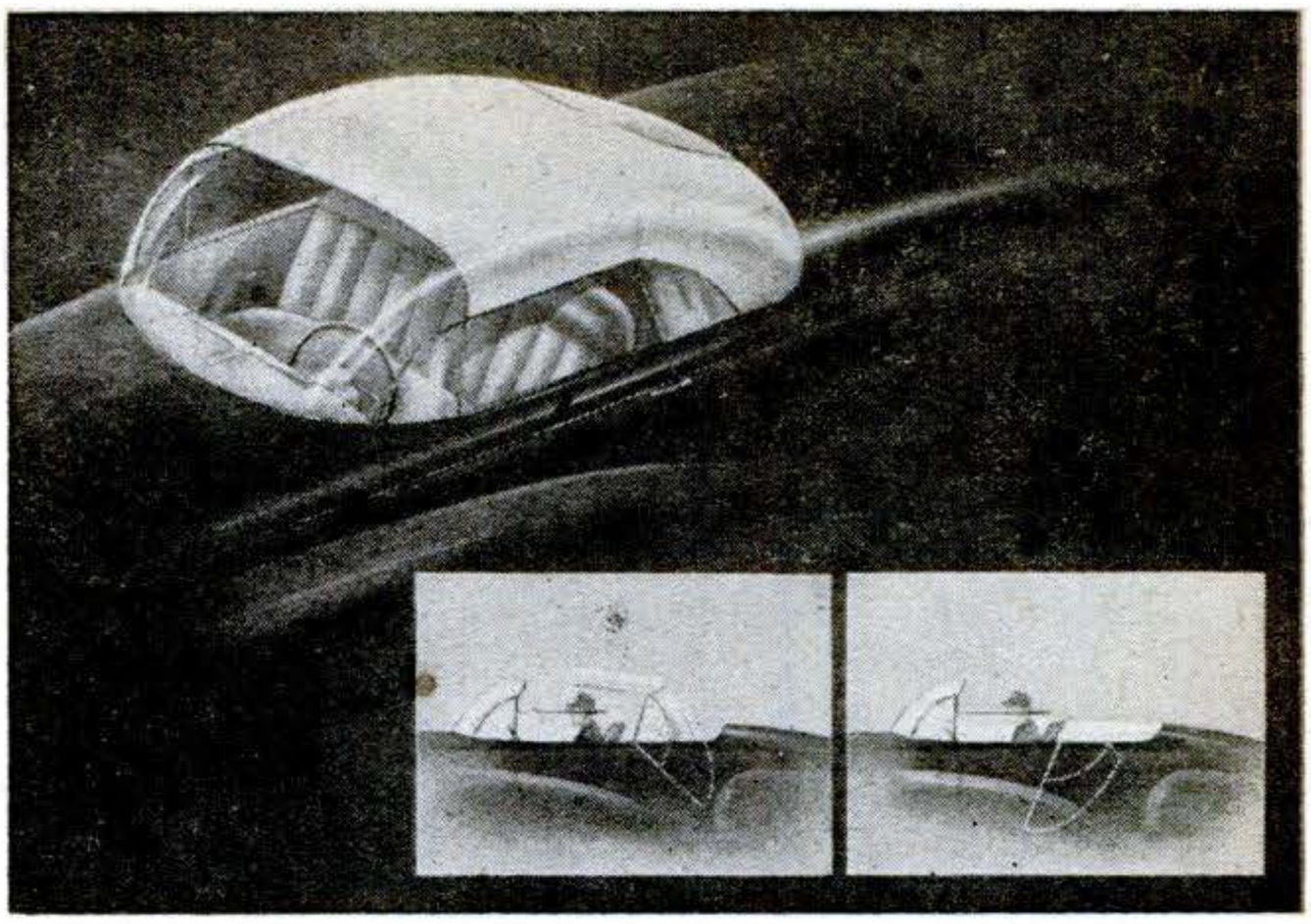
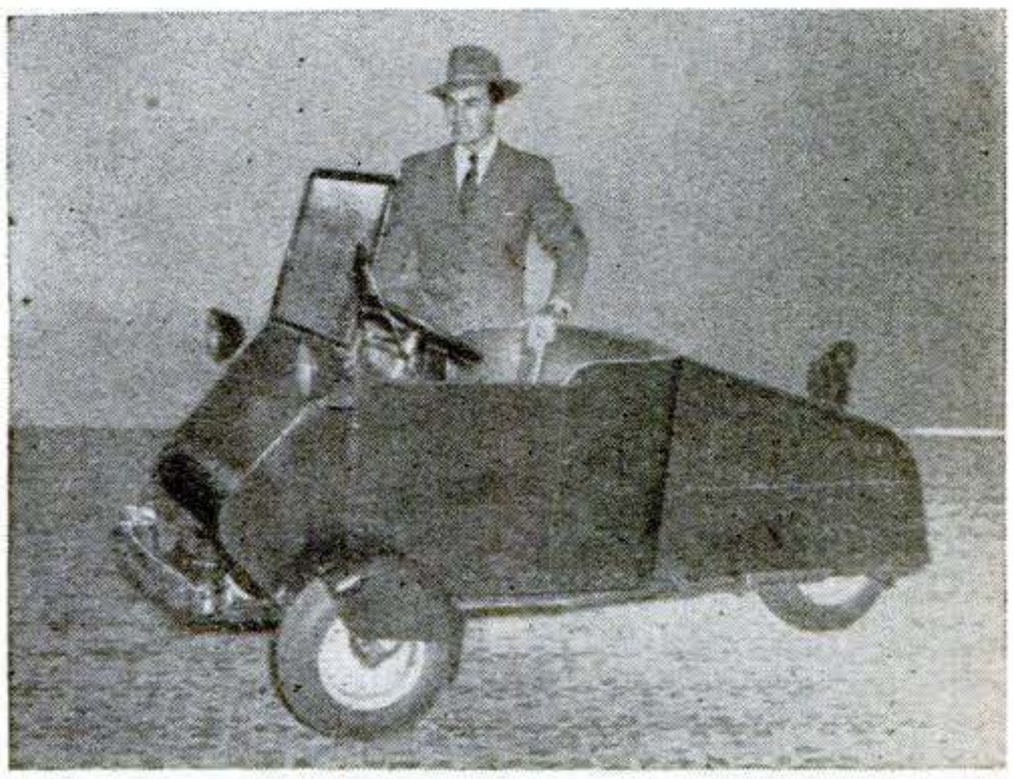
A FOLDING HARD TOP, designed by the Motor State Products Company, of Detroit, lowers automatically at the touch of a button. The curved back section drops out of sight behind the seat and the front also swings back into place to form a closed deck. When the top is up, its smooth contours match the body lines. The curved windshield, formed of safety glass, provides unobstructed vision, and there's an extra-large rear window. While this top design is limited to single-seaters, others for two-seat cars may be produced in the future on similar lines.



ABOUT FACE! If you should call a cab when next you visit Paris, the vehicle that arrives may confuse you by apparently running backward. A close examination of the photo at the left will indicate how such a misunderstanding might occur. This vehicle, chosen at an automobile exposition in the French capital as "the taxi of tomorrow," faces to the left (in case you're still confused) and the hood-like extension at the other end actually is a luggage compartment. The cab carries six passengers. A sign on the top shows when it is free.

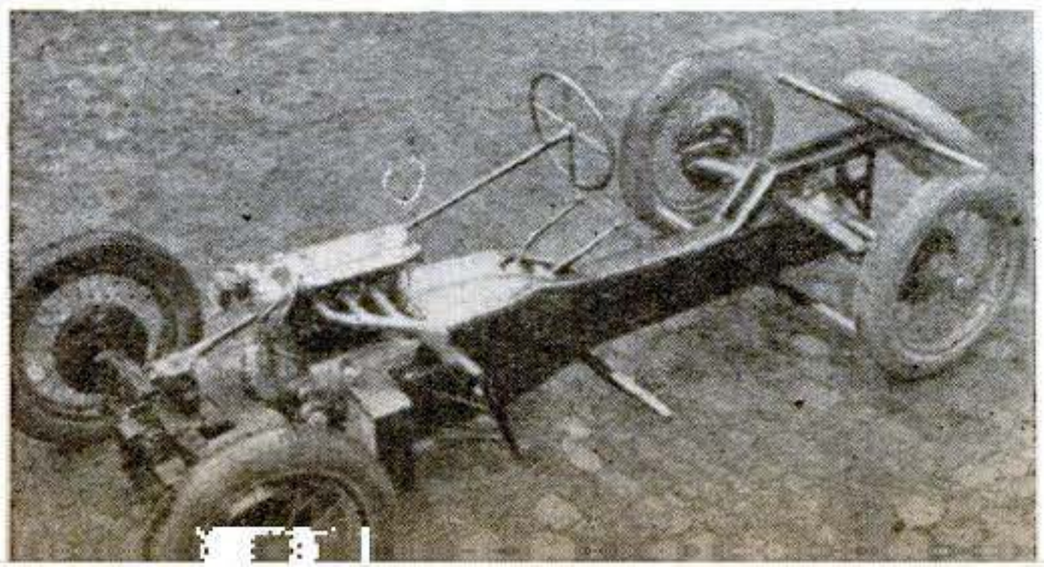
HOME-BUILT CARS may not have all the trimmings of the commercial product, but they afford the builder a lot of fun and a chance to try out his own pet ideas. Here are two examples of such improvisation.

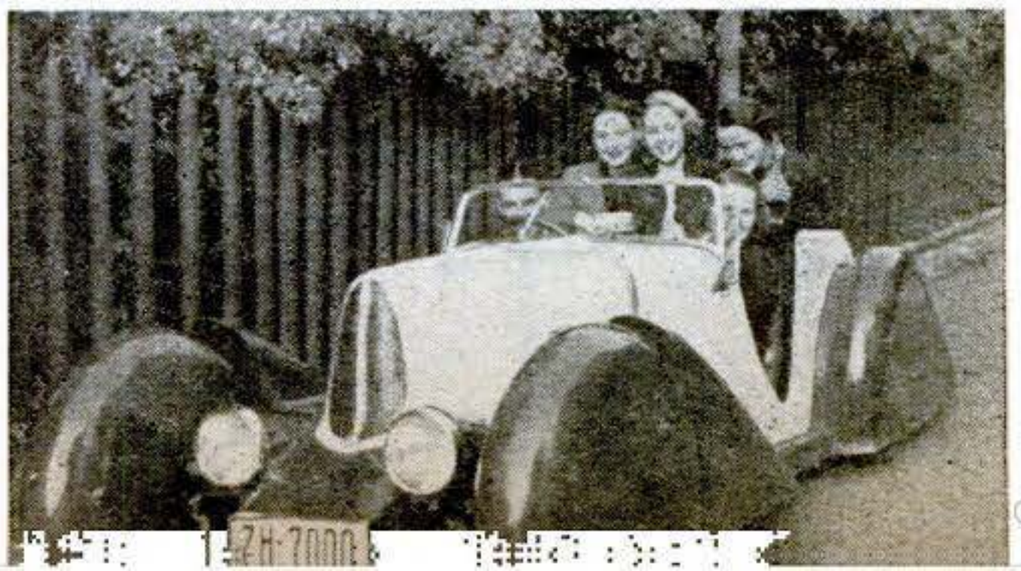
At the right is a two-passenger vehicle devised by Robert E. Taylor, of Bridgeport, Conn., from a Cushman motor scooter. Powered by a 4-hp. engine, it is capable of 30 m.p.h., has two speeds forward and a storage battery to operate an electric starter, lights, and horn. The steering wheel was taken from a motorboat.



As reported in "GM Folks," employee publication of the General Motors Corporation, the car shown in the photos below was built by Walter Wyss in his native Switzerland in 1935. Wyss now is an engineer with the Chevrolet Motor Division in Detroit.

The second of two cars that he built before coming to the United States, this one had a single-beam frame, a radiator on each side of the 4-cylinder engine, and four speeds forward. It could attain a speed of 85 m.p.h. The streamlined front fenders were shaped to the wheels and moved with them when the car was steered.





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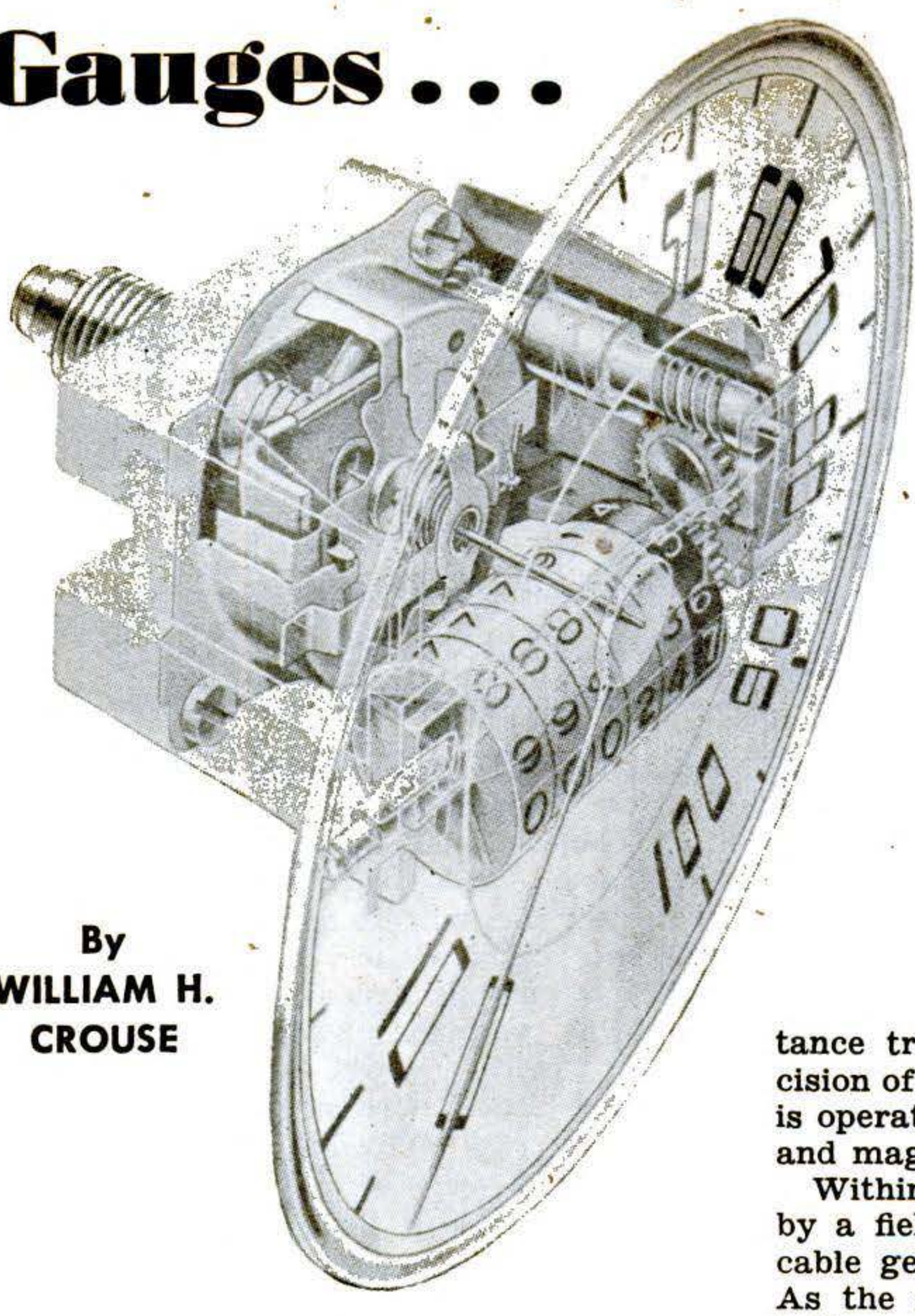
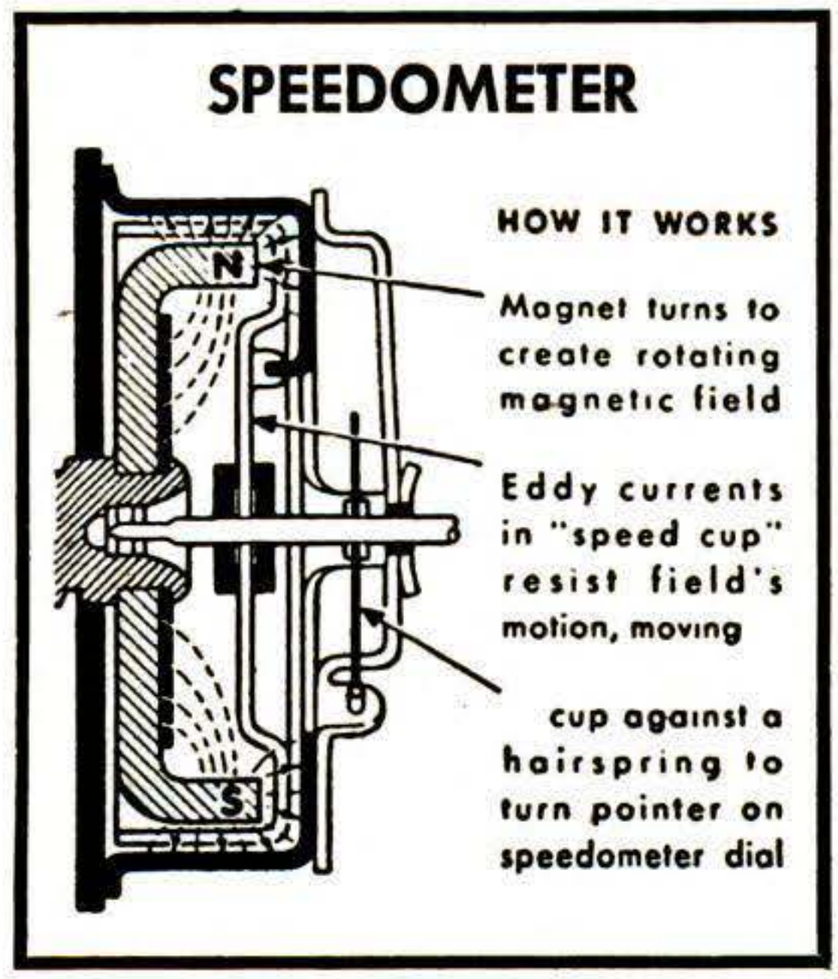
Gauges . . . Sentinels



By
WILLIAM H.
CROUSE



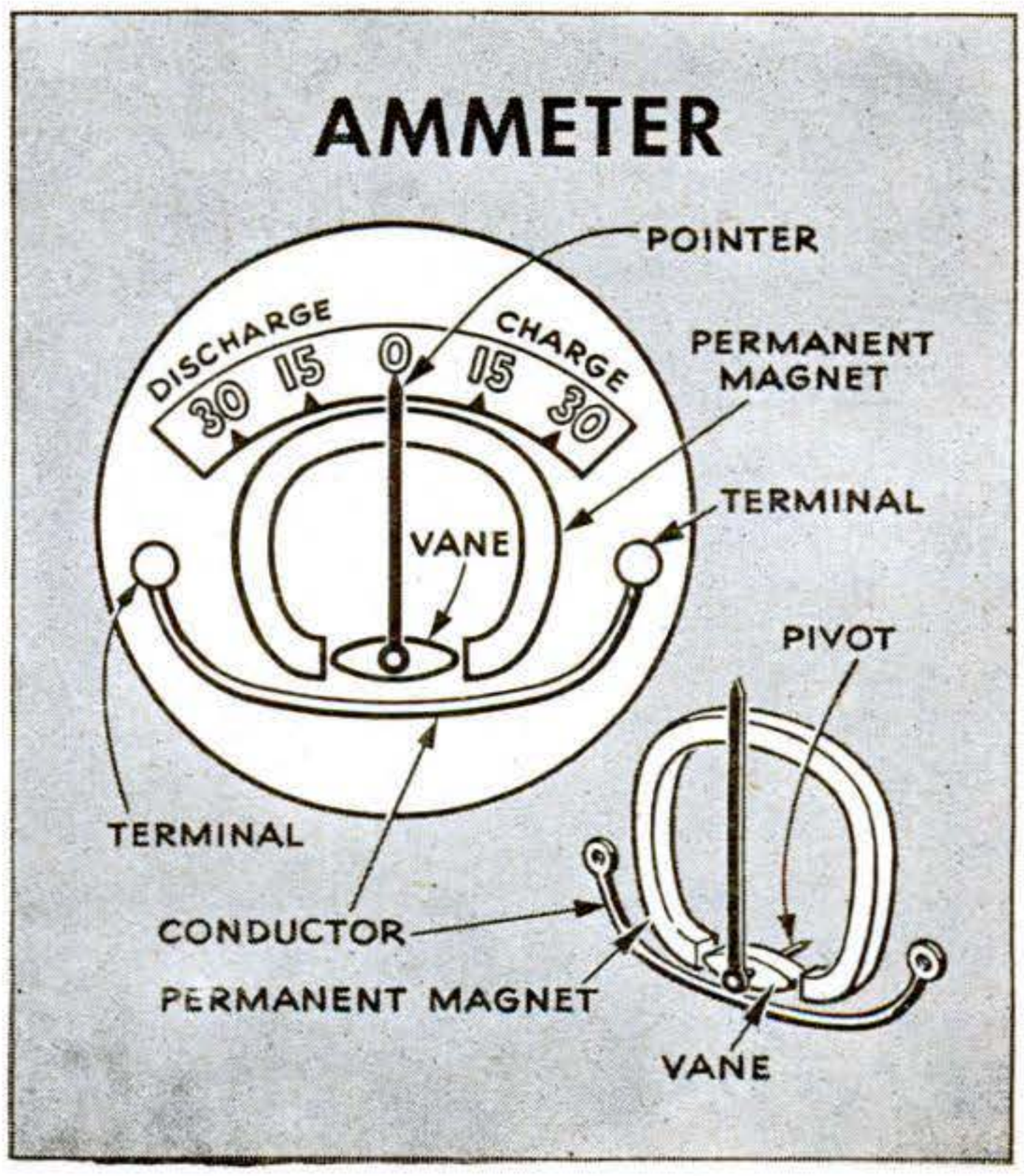
ON THE dashboard of the modern car are five remarkable indicating instruments—the speedometer, ammeter, and the fuel, engine-temperature, and oil-pressure gauges. While practically every driver consults the speedometer and fuel gauge frequently, many persons are inclined to neglect the others—not realizing, perhaps, that they are sentinels placed to warn of present or impending trouble.

Low or unsteady oil pressure, for example, may indicate that the engine bearings are in danger of burning out because of poor lubrication, and high pressure may mean that an obstruction in the line has cut off normal oil delivery to the engine parts. Likewise, overheating of the engine or excessive ammeter readings are danger signs that should not be disregarded.

Dashboard instruments, like the cars themselves, reached their present stage of efficiency through step-by-step evolution. Each has a definite job to perform, and the driver who knows what it is and understands how it is done may expect to get the maximum mileage out of each driving dollar.

By dictionary definition, a speedometer actually is two instruments in one—a speedometer (for measuring the velocity of the car) and an odometer (for recording the distance traveled). Assembled with the precision of a fine watch, a modern speedometer is operated by a combination of mechanical and magnetic principles.

Within an aluminum cup that is encircled by a field plate, a magnet is rotated by a cable geared to the drive shaft of the car. As the magnet revolves, setting up a rotating magnetic field, eddy currents are built up in the aluminum cup in strength proportional to the speed, causing it to turn slowly against a delicate hairspring. A hand



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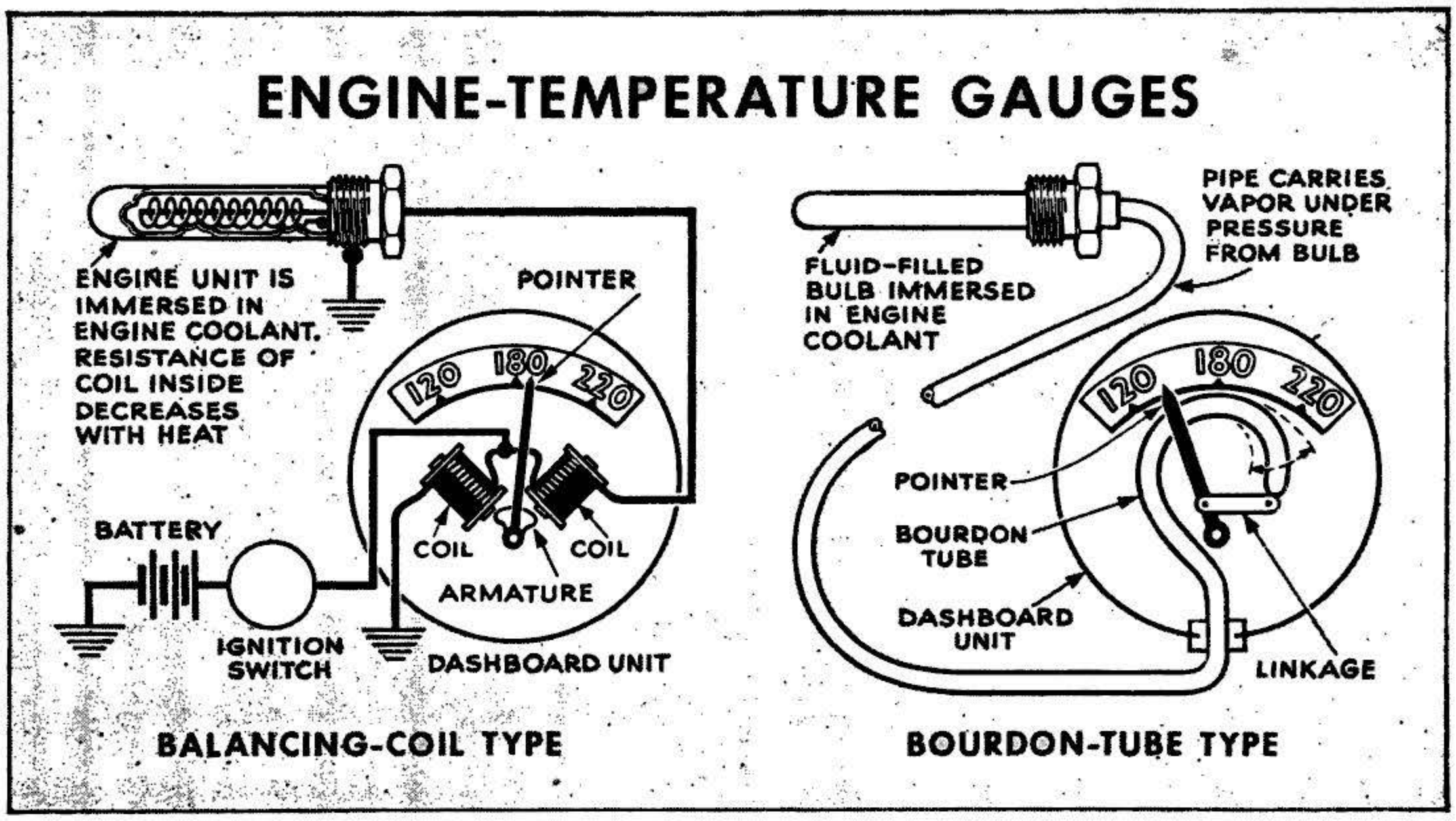
That Guard Your Car

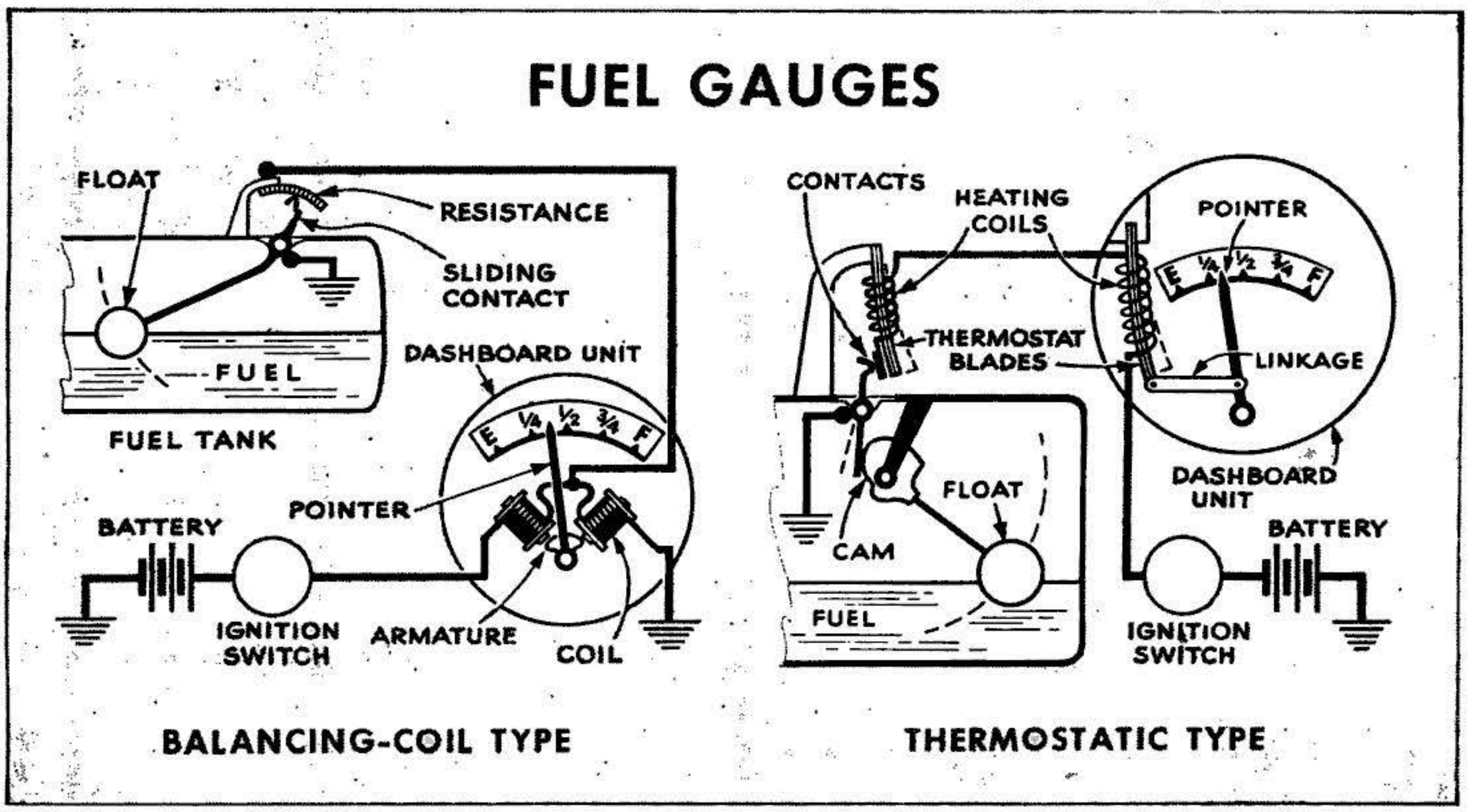


on the end of the cup shaft affords a reading on the speedometer dial. Worm gears, also operated by the cable from the drive shaft, turn the odometer and provide a record of the mileage traveled.

The ammeter is the watchdog of the electrical system. Except for current used by the cranking motor, all current flowing to or from the battery passes through it. When the generator is supplying more current than the electrical equipment on the car is consuming, current flows to the battery and the ammeter indicates "charge." When the generator is not supplying sufficient current to handle the load, the battery must make up the deficit, and the ammeter indicates "discharge."

Automotive-type ammeters usually consist of a permanent magnet, a needle attached to a pivoted soft-iron vane, and a

Gauge Drawings by STEWART ROUSE.



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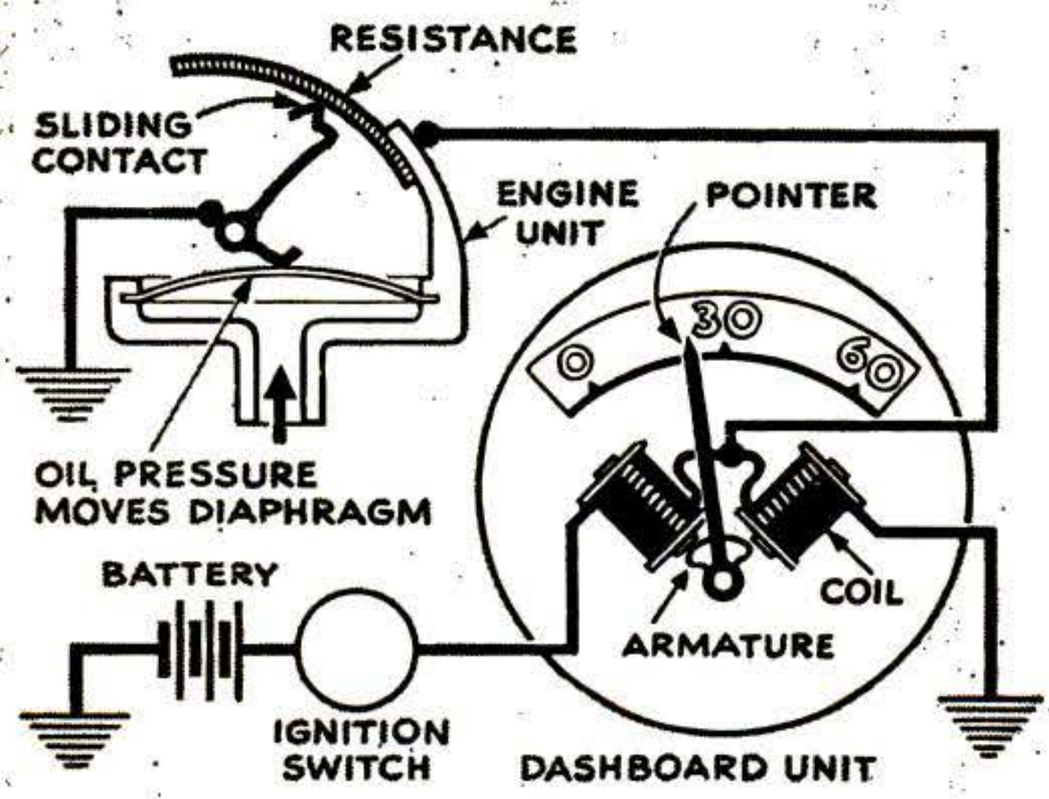
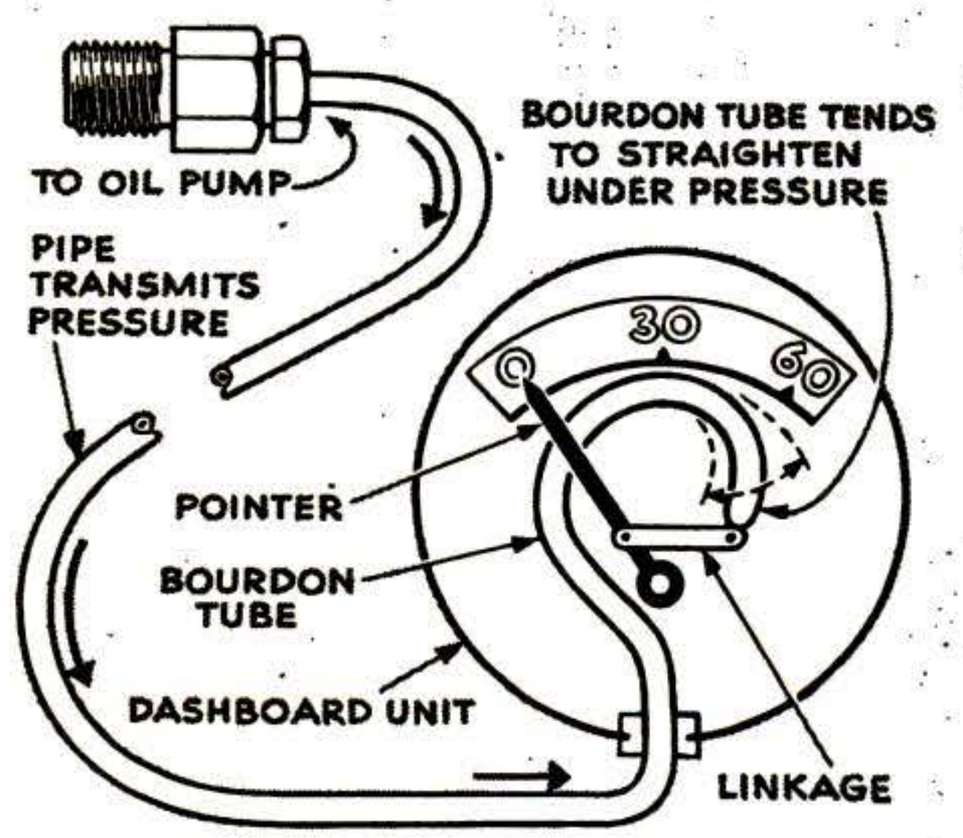
OIL-PRESSURE GAUGES



BALANCING-COIL TYPE



BOURDON-TUBE TYPE

conductor placed close to the vane. When no current is flowing, the magnet holds the vane so that the needle points to zero. When current begins to flow, a magnetic field that builds up around the conductor distorts the even pull of the permanent magnet, causing the vane to pivot. The direction of the flow determines whether the needle swings to the charge or discharge side, and the amount of current determines how far it swings.

Whereas the ammeter reports directly on the action of the electrical system, other instruments react first to thermal or physical changes in other parts of the car and then convey their report to the dashboard by electrical means. There are two general types of electrically operated gauges, the balancing-coil or magnetic, and the bimetal or thermostatic. All are connected to the battery through the ignition switch to prevent battery drain when the car is idle.

Balancing-coil gauges, whether for fuel, engine temperature, or oil pressure, work on the principle of an engine or tank unit containing a variable resistance and a dashboard unit containing two coils and a small pivoted armature to which the pointer is attached. The right-hand coil is wound so that, with equal current flowing in both coils, it exerts the stronger pull. The gauge is operated by a fraction of an ampere of electrical current flowing from the battery through the coils and resistance. When resistance is low, most of the current from the battery, after flowing through the left-hand coil in the dash unit, passes on through the engine or tank unit, sidestepping the right-hand coil. Consequently, the left coil is magnetically strong, the right is weak, and the armature pivots to the left, indicating a low fuel supply, engine temperature, or oil pressure, whichever the case may be. When resistance is increased in the engine unit, the magnetic strength of the right-hand coil equals or exceeds that of the one on the left. Hence the pointer moves to the right.

In the case of the balancing-coil oil gauge, changes in the oil pressure actuate a flexible diaphragm in the engine unit, and the diaphragm operates a sliding contact that changes the resistance. In a fuel gauge a float performs the same function. Instead of a float or diaphragm, the balancing-coil temperature gauge has an engine unit consisting of a coil the resistance of which decreases with heat; and the two coils are connected in a slightly different way.

Two strips of different metals, placed face to face, are employed in bimetal or thermostatic gauges. As the temperature increases, the metals expand at different rates and cause the strips to bend or warp. In the thermostatic fuel gauge, the tank unit and dash unit each contain a thermostat blade and a heater wire, the wires being connected in series to the battery. In operation, the same amount of current flows through both wires, heating the thermostats equally and causing them to bend a like amount. But a float and cam, through pressure on a pivoted contact arm, give the tank thermostat an initial bend; the higher the fuel level the greater the bend. When current flows, the dash thermostat is heated and hence bent until it duplicates the pressure bend exerted on the tank thermostat. In consequence, linkage in the dash unit moves the pointer to indicate the amount of gasoline in

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the tank. The two thermostats, however, continue bending at an equal rate. Almost immediately the one in the tank unit pulls away from the contact arm, breaking the electrical circuit. The blade then cools and straightens back against the contacts, but again breaks away when the blade heats. This opening and closing of the circuit continues at a frequency of about once a second, and the pointer remains virtually stationary.

A variation of this thermostatic gauge design uses a variable resistance in the tank unit and thermostat blades in the dash unit. The resistance passes varying amounts of current in accordance with the fuel level.

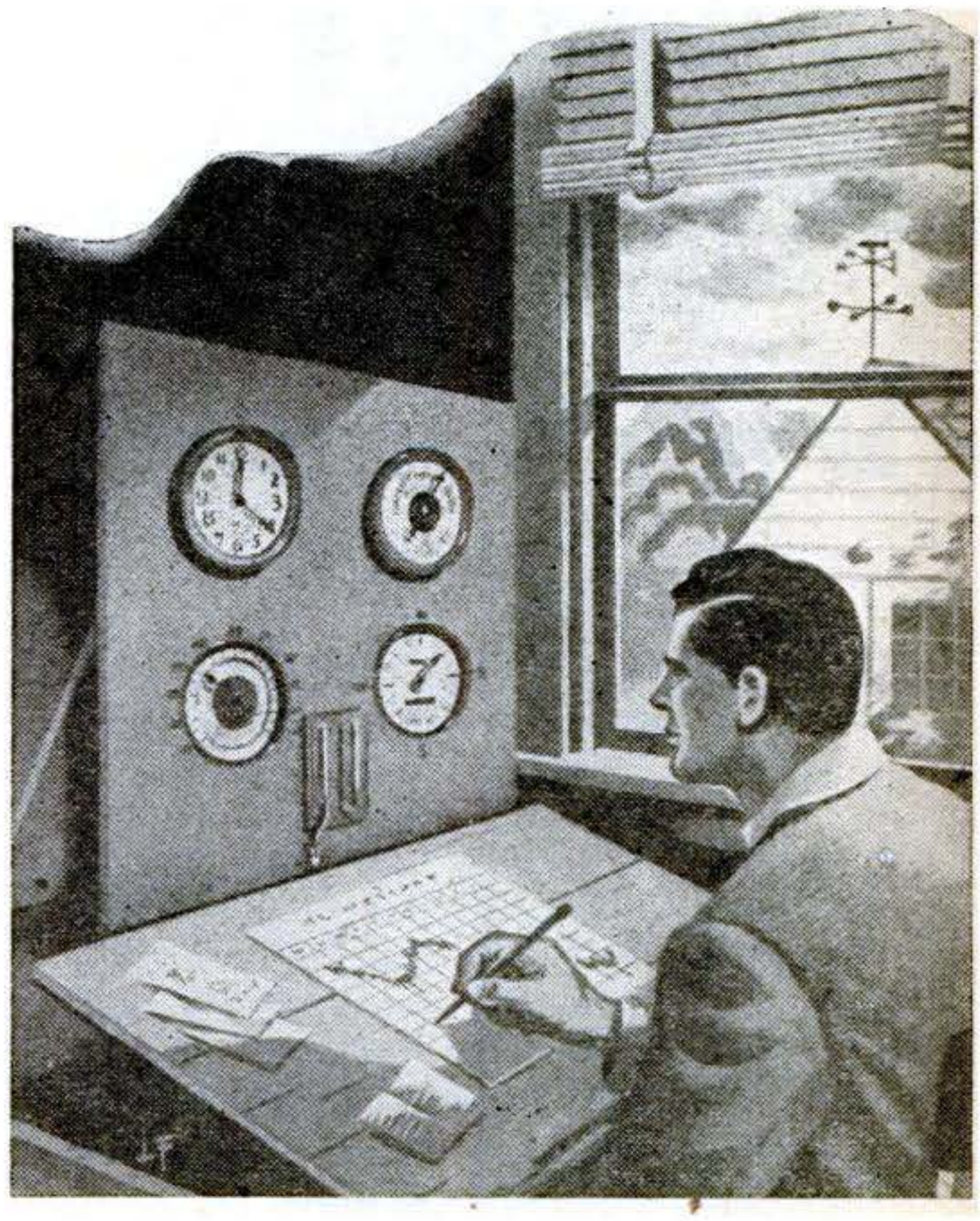
Bourdon tubes (named for the inventor, Louis Bourdon) are employed in the dash units of mechanically operated engine-temperature and oil-pressure gauges. Curved and closed at one end, this tube straightens slightly when pressure is applied at the open end, the closed end moving in proportion to the pressure. Linkage and a pointer give a reading on the dashboard dial. In an oil gauge, pressure from the engine oil pump is applied to the Bourdon tube through a connecting tube. A temperature gauge has a dash unit similar to the oil pressure gauge and an engine unit consisting of a bulb filled with liquid that has a low boiling point. Immersed in the engine cooling water, the bulb is connected by a tube to the dash unit. As engine temperature increases, the liquid creates pressure in direct proportion to it.

$100 IN PRIZES FOR INGENIOUS USES OF OLD DASHBOARD GAUGES

$100 IN CASH PRIZES

First $50
Second 25
Third 10

And three others of $5 each.



MANY dashboard instruments are allowed to rust away in junkyards. Did the sight ever prod your mental cogwheels into action, pondering ways of putting these perfectly good instruments to use?

For instance, you might convert an old speedometer into an anemometer, or a remote-reading wind-direction indicator. Or you might install a fuel gauge to give remote readings of water in a well or cistern, modify an oil gauge to give furnace steam-pressure readings in your living room, adapt an engine-temperature gauge to a home hot-water system, or wire an ammeter as an indicator signal that the cellar light is on. There is virtually no end to such possibilities.

This contest offers a total of $100 in prizes for the best adaptations of the five major dashboard instruments. When practicable, the contestant should submit the gadget itself along with a clear installation and circuit diagram. Otherwise, detailed photos and diagrams will be accepted, but in the latter case the entry must be accompanied by a signed statement that the device has actually been built and works as represented. Entries will be returned only if the necessary postage is supplied.

Entries should be addressed to the Dashboard Gauge Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y., and must bear a postmark not later than May 31, 1946. Employees of this magazine are not eligible to compete. In case of ties, duplicate prizes will be awarded. Decisions of the judges will be final.

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Gus Short-Circuits

By MARTIN BUNN

GUS WILSON finished tightening the nuts on the clutch-to-transmission housing of George Miller's sedan and turned to Stan Hicks.

"Now Mrs. Miller won't have any more trouble with the shift lever jumping out of gear when she's in sticky traffic and her usual dither," he said. "Remember, kid, that's the way to cure that particular pain in the neck—loosen all the nuts on the housing, and then tighten them carefully and evenly, just the way you tighten the nuts on a cylinder head. Even a slight—"

"When you've finished that lecture," broke in a disagreeable voice, "maybe you'll have time to give *me* some attention."

Gus looked around and, without the slightest pleasure, recognized the grouchy face of Anson Fielder, local superintendent of the electric-power company.

"Oh, Mr. Fielder," Gus said, his usual cordiality lacking. "I didn't hear you come in. Want something?"

"Why do you think I'm here?" Fielder replied tartly. "I want you to look at my car."

Fielder drove an expensive but somewhat battered station wagon into the shop. When he got out he screwed his face up as if he were in pain. "Sprained my ankle," he explained ungraciously. "I ought to be home in bed, and I would be if there was anyone at the plant I could trust. . . . One of my pistons is shot."

Gus's educated ears had already told him that. "So I hear," he agreed. He did a quick job of checking while Fielder watched impatiently. "It's the piston of the No. 2 cylinder," he said. "I'll put a new one in."

"No you won't," Fielder told him. "You order a new piston, and I'll install it myself—it'll save me money and I'll probably do a better job. Take the old piston out, and I'll have one of our trucks tow the car out to my place in the country. There's other work I want to do on it. How long will it take to get a piston?"

"Two or three days—maybe more," Gus said. "You'd better leave the old one in until then. You can drive with it, anyway. The Weather Bureau predicts snow, and you won't want to be marooned without a car."

"That's my lookout," Fielder snapped.

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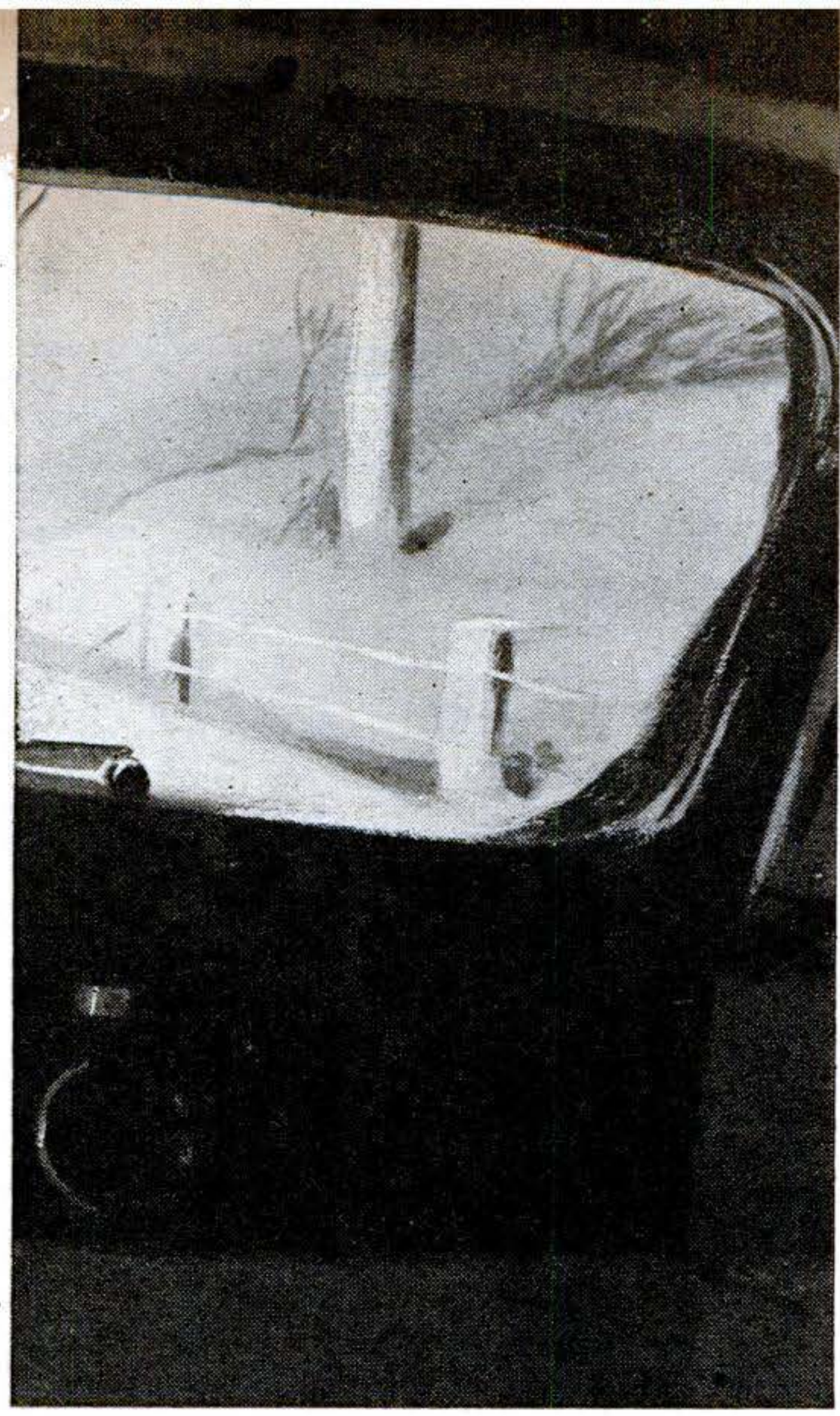

"I saw a man jump into a station wagon and drive off," Dale said. "My lights caught the station wagon, and I'm almost sure it was Mr. Fielder's."

an Alibi

"And besides, the Weather Bureau's wrong nine times out of ten. The truck will be here for the car at four o'clock."

That was Tuesday noon. On Thursday morning, in spite of Anson Fielder's contempt for Weather Bureau forecasts, Gus changed into his work clothes to an accompaniment of the slap of tire chains and the scrape of snow shovels in the street outside.

"I got the driveway clear," Stan said. "Some storm. It's pretty near two feet deep. What time did the lights go out?"

"About two," Gus answered. "And they didn't go back on until after seven this morning. Our friend Anson Fielder will get panned plenty for that breakdown." A horn squawked outside. "Better open the door."

Stan did, letting in a smart-looking coupe from which stepped George E. Bevens, the president of the power company and an old friend of Gus's.

"Morning," he greeted. "Wasn't sure I'd make it in the snow. Will you get that ring job done as soon as you can, Gus? I've got a date in Florida next week—with a sailfish. Want to come along?"

Gus saw that in spite of his offhand words Bevens's florid face was serious. "What's the matter, George?" he asked. "Worrying about that breakdown?"

Bevens looked around to make sure he and Gus were alone. "It was a bad one," he confided, "but what worries me most is that young Dale Grant failed to meet the emergency. I expect wires to go down in a sleet and snow storm, but I *don't* expect them to stay down for five hours."

"Dale Grant?" Gus asked. "How is Dale to blame? Fielder is the plant super—it's up to him to keep juice flowing, isn't it?"

"Normally, yes," Bevens replied. "But he was off duty yesterday with a sprained ankle, and when they reached him by phone his car was shot and he couldn't come in until they had sent another car out into the country for him. Meanwhile, Grant was called in, and he didn't get the mess cleaned up until just before Fielder finally made it. Frankly, I'm disappointed. I had picked young Grant for the job of general superintendent—over the head of Fielder."

Gus has known Dale Grant since he was an electricity-crazy kid in knee pants, and after the boy came home from college and went to work for the power company, he took almost fatherly pride in his quick climb to the job of assistant superintendent. He was still thinking about him when Dale himself came into the shop half an hour later.

"I want your advice about something important, Mr. Wilson," Dale said. "There were some queer things about that breakdown. One was that the wires that went down were *cut*—although whoever did it made a good job of making the cuts look like breaks. Another was that the wires were cut at *seven* places."

He paused and stared out of the window. "But this is the real screwy part," he went on at last. "When I was on my way to the power house, I saw a man jump into a station wagon at one of the spots where a break was found and drive down a side road. I couldn't see him plainly, but my lights caught the station wagon, and I'm almost sure it was Mr. Fielder's. It wasn't until an hour later that we got him on the phone, and phone service wasn't affected by the storm. He told us then that a piston was missing from his station wagon."

"That's right," Gus commented.

Dale shrugged hopelessly. "That leaves me behind the eight ball," he said. "His station wagon couldn't have been where I saw it if it was minus a piston."

"You and Fielder friends?" Gus asked.

"We got along fairly well," Dale told him,

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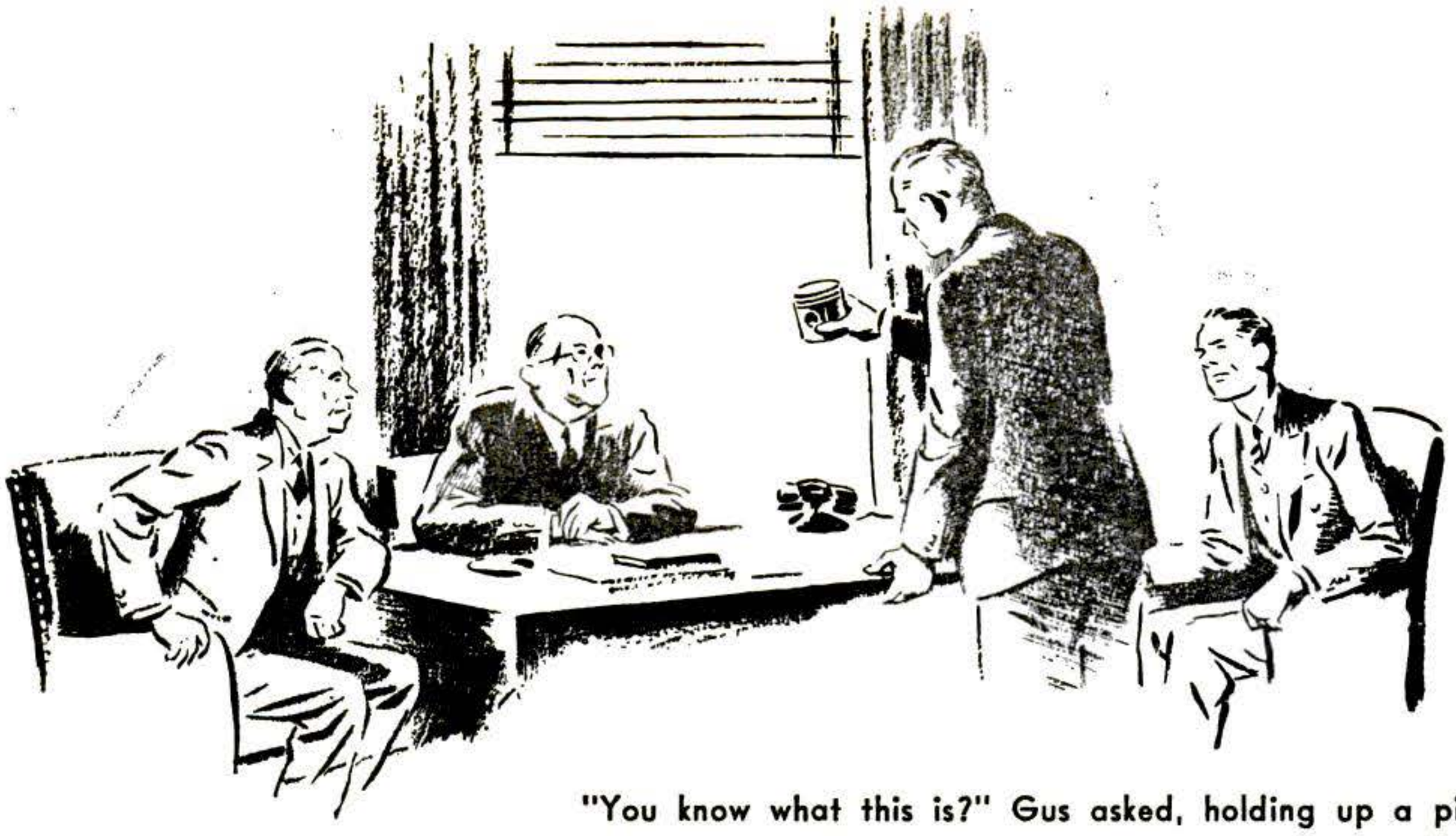

"You know what this is?" Gus asked, holding up a piston.

"or at least we did until he got the idea that Mr. Bevens might promote me to general superintendent. But what I want to know is whether I should tell all this to Mr. Bevens."

Gus smoked his pipe silently for at least two minutes before he answered. Then he said: "Yes, tell him."

An hour later Joe Clark came into the shop to say that Bevens was on the phone and wanted Gus to come to his office.

"Tell him I'll be over," Gus said.

Dale and Fielder were with Bevens. "There are a few questions about Fielder's station wagon that I'd be obliged to have you answer, Gus," Bevens said.

"That's up to Mr. Fielder," Gus replied.

"Go ahead," Fielder snapped, giving Dale a hard look. "*I* haven't anything to hide."

"Fielder tells me," Bevens went on, "that you removed one of the pistons from his engine Tuesday and ordered a new one that hasn't yet been delivered."

"That's right," Gus agreed.

"Now," Bevens continued, "I want you to do this for me, Gus—drive out to Fielder's house, examine his car, and report to me."

"Here's the garage key," Fielder said. "Lock the door when you leave."

GUS drove fast, let himself into Fielder's garage, checked over the engine, and then drove back. He reported that he had found the engine still minus its No. 2 piston.

Fielder's face showed his pleasure. "Well, Mr. Dale Grant," he smirked, "where is your cock-and-bull story now?"

Bevens frowned. "That proves that Fielder couldn't have driven out last night and couldn't have had anything to do with the breakdown." He looked at Dale regretfully. "Considering that there were seven different breaks in the line, I was ready to pass over the delay in restoring service, but for you to lie in an attempt to shift the blame . . ."

"Wait a minute, George," Gus cut in. "How do you know Fielder couldn't have driven his station wagon last night? Give me an hour, and I'll prove that he could."

Bevens stared at him. Then he nodded. "All right, I'll give you an hour."

OUT of breath and pretty well covered with grease, Gus was back in 50 minutes. "You know what this is, don't you?" he asked Bevens, holding up a piston.

"It's an automobile piston, of course."

"The piston out of the No. 2 cylinder of *your* automobile, George," Gus supplemented. "You left your coupe in my shop for a ring job today. I have just removed this piston and the rod, adjusted the valves, buttoned up the engine, and driven the car over from the shop. You now have a seven-cylinder car. It doesn't run very smoothly, but I could drive it across the country and back if I had to. There is every reason to believe that Fielder could do just what I've done—he was going to install the new piston himself, so he must know engines."

Fielder's face had turned chalk white when Bevens looked around at him.

"You hardly need to admit anything, Fielder," Bevens told him. "Your face does that for you. But you can save talking to the county prosecutor if you resign now."

Fielder's chin fell. He nodded consent.

"And you, Grant," Bevens went on, "get yourself a good rest from your night's work against sabotage and report tomorrow—as general superintendent. Gus, I *am* much obliged. That invitation to meet a sailfish in Florida next week still stands."

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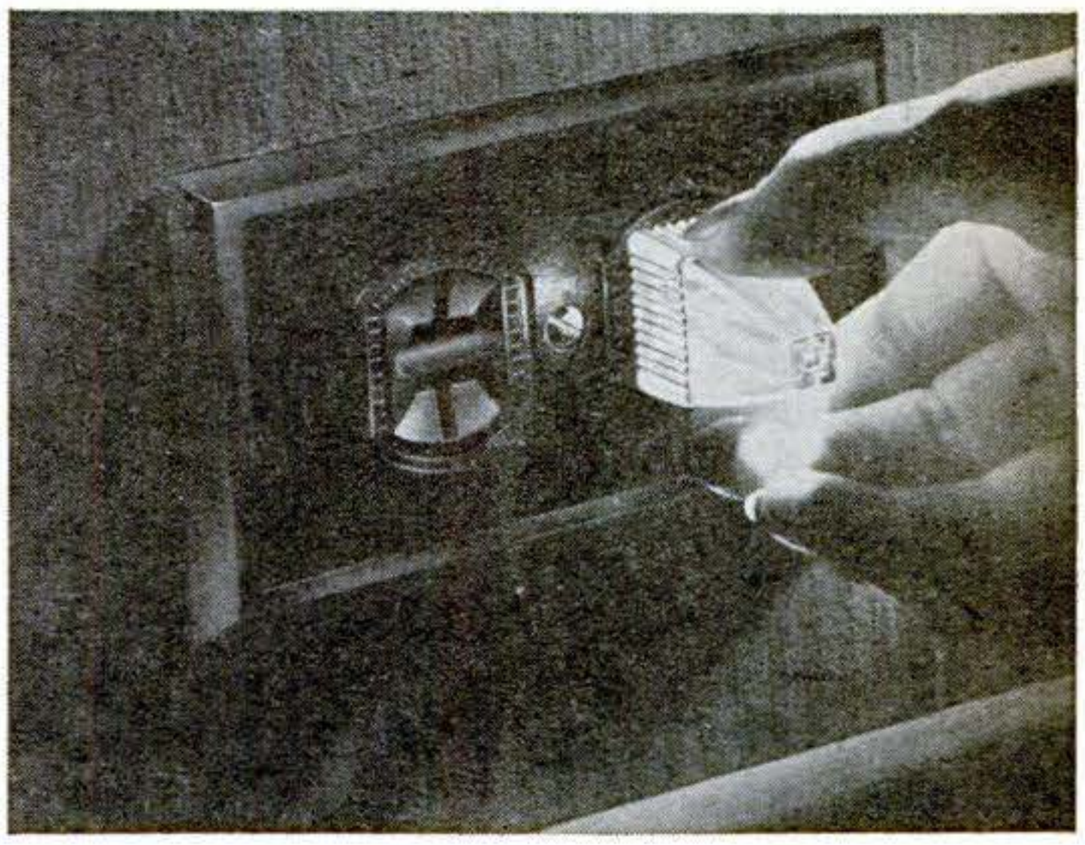
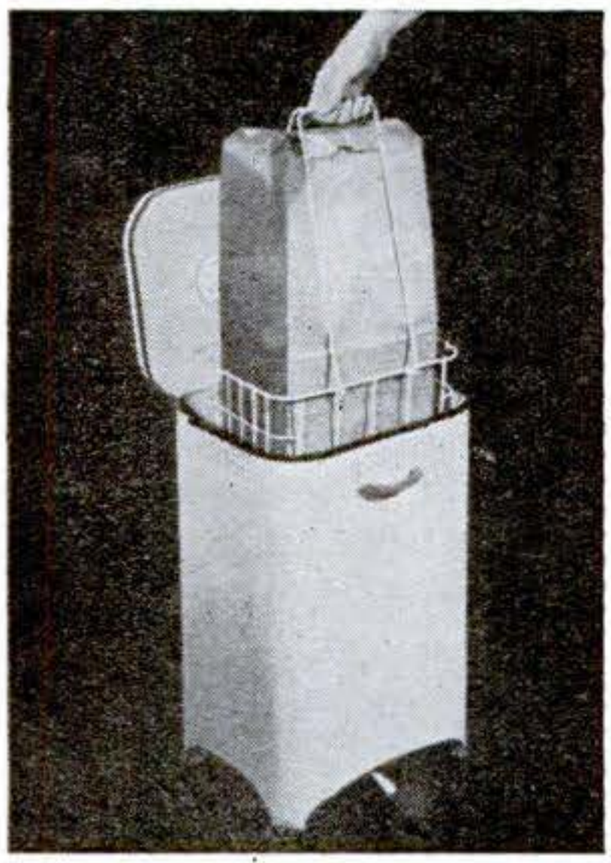
modern living

WASHING MACHINES designed for small apartment-house kitchens are now reaching the market from many sources. The portable model shown above is a product of the Menasco Mfg. Co., of Burbank, Calif.

Similar machines are available in a variety of sizes, and will probably be popular in hotels, trailers, and tourist camps, as well as in tiny kitchenettes.

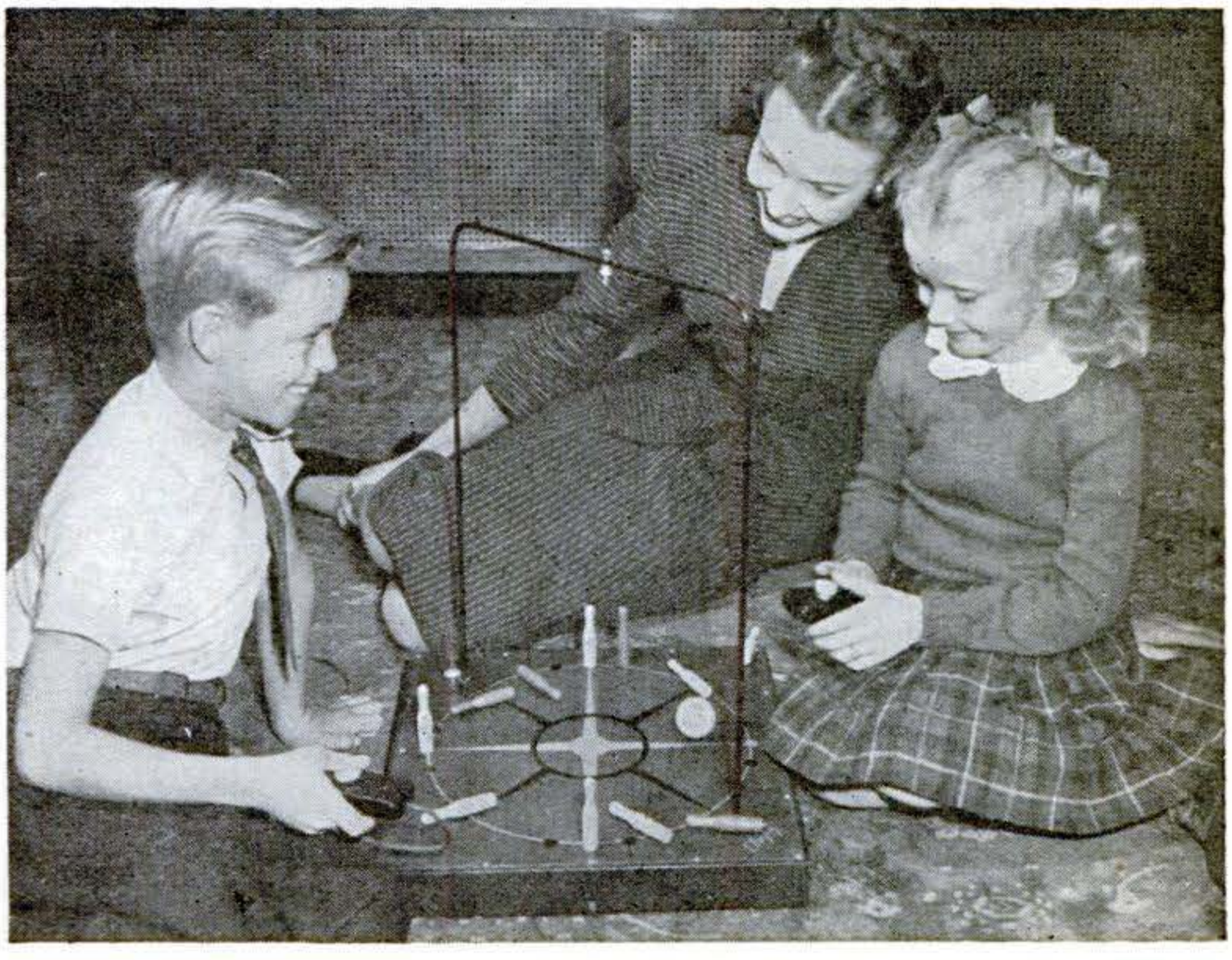


PLASTIC NIGHT LIGHTS that serve to show the location of switches or guide a person through a darkened house are made by Littelfuse., Inc., of Chicago. The bulb forms an integral part of the plastic housing. Giving a very soft light, the bulb isn't likely to disturb a sleeper. In continuous operation it costs only about one cent a month for the electricity it consumes.



CLEANER garbage disposal is the object of this ventilated, chemically deodorized refuse container available from Hammacher Schlemmer, of New York. Refuse is placed in a disposable paper bag which fits into a wire frame inside the container. A pedal raises the lid.

MAKING IT UP TO CHILDREN who had to do with fewer and poorer toys during the long years of shortages, electric and electronic toys are bringing wartime design features into the playroom. Below, two delighted youngsters demonstrate a new buzz-ball game. Players manipulate an electric force by means of individual switches. The game is one of a series produced by Electronic Laboratories, of Indianapolis, Ind.



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LIGHTWEIGHT TRAILER FOR WEEK-END VACATIONS

By John Gartner

PART 1

LESS than a thousand pounds of fully equipped trailer makes the kind of companion your car will be glad to take along on any trip. For all-year living, or leisurely travel on the main highways, the big commercial jobs still deserve your vote. But for quick week-end trips, cross-country jaunts over the mountains, or side-road excursions, you will want a lightweight traveler that gives you plenty of road clearance, tracks smoothly at any speed, and will even follow you off the road like Mary's little lamb.

You can get some of these things just by tying a kiddy car to the rear bumper, but you'd still be missing a good bet, for this trailer is no toy. It sleeps two adults and has plenty of room for two children on the floor, not to mention storage space for the family's needs. Measuring 10′ in length and 6½′ in width, it allows full headroom for a six footer with shoes on. You can get some idea of what it's like from the pictures on these pages; for a still better view of the finished job, see the color photos by Frank Lindgren, Jr., on page 117.

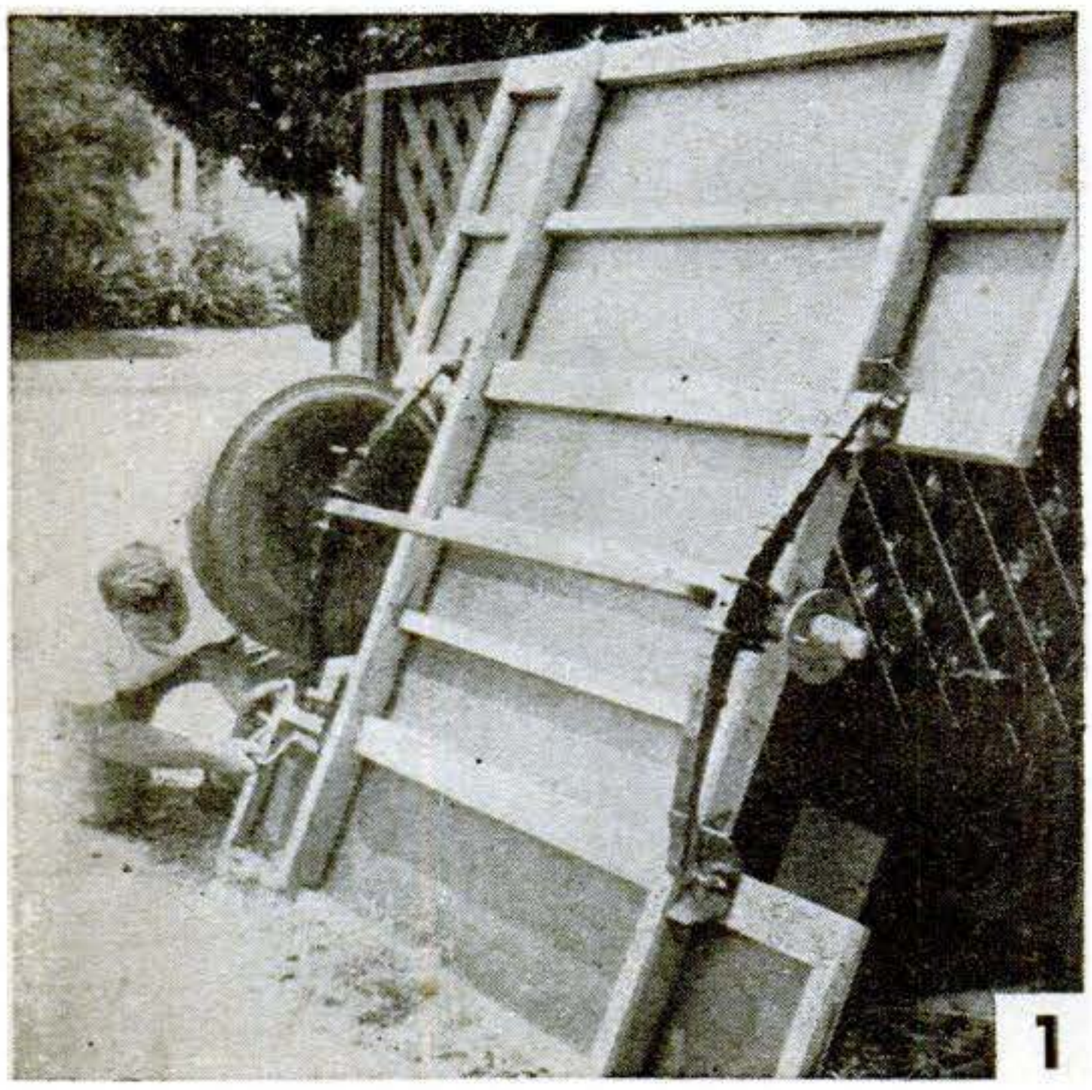
Cost is bound to be a major factor in any project of this size, but no close approximation can be given because many of the parts will vary according to availability, regional price differences, and quality. Reasonable estimates of the total cost run from about $200 to $450.

THE HOME AND WORKSHOP

It will be helpful to have most of the materials on hand before beginning construction. The sizes of window, door, and vent openings will depend on the fixtures you can procure, and your axle and spring assembly will govern the size of the fender wells and the spacing of the frame members.

Hand tools are all you really need, but of course power tools will help a great deal. First, clear a space on the ground and lay out the frame as shown in a drawing on page 149. Smear all joints liberally with waterproof glue, make sure crosspieces are square with the stringers, and bolt the pieces together with carriage bolts and lag screws; the side members will have to be counterbored for the lag screws.

As shown in the drawing, the forward crosspiece between the wheel openings is centered exactly 4′ from the front edge. Place a sheet of ⅜″ by 4′ by 8′ waterproof plywood sideways across this portion of the frame, saw off 18″ from the length, and secure the plywood with glue and drive screws. Trim another piece to cover the remainder,



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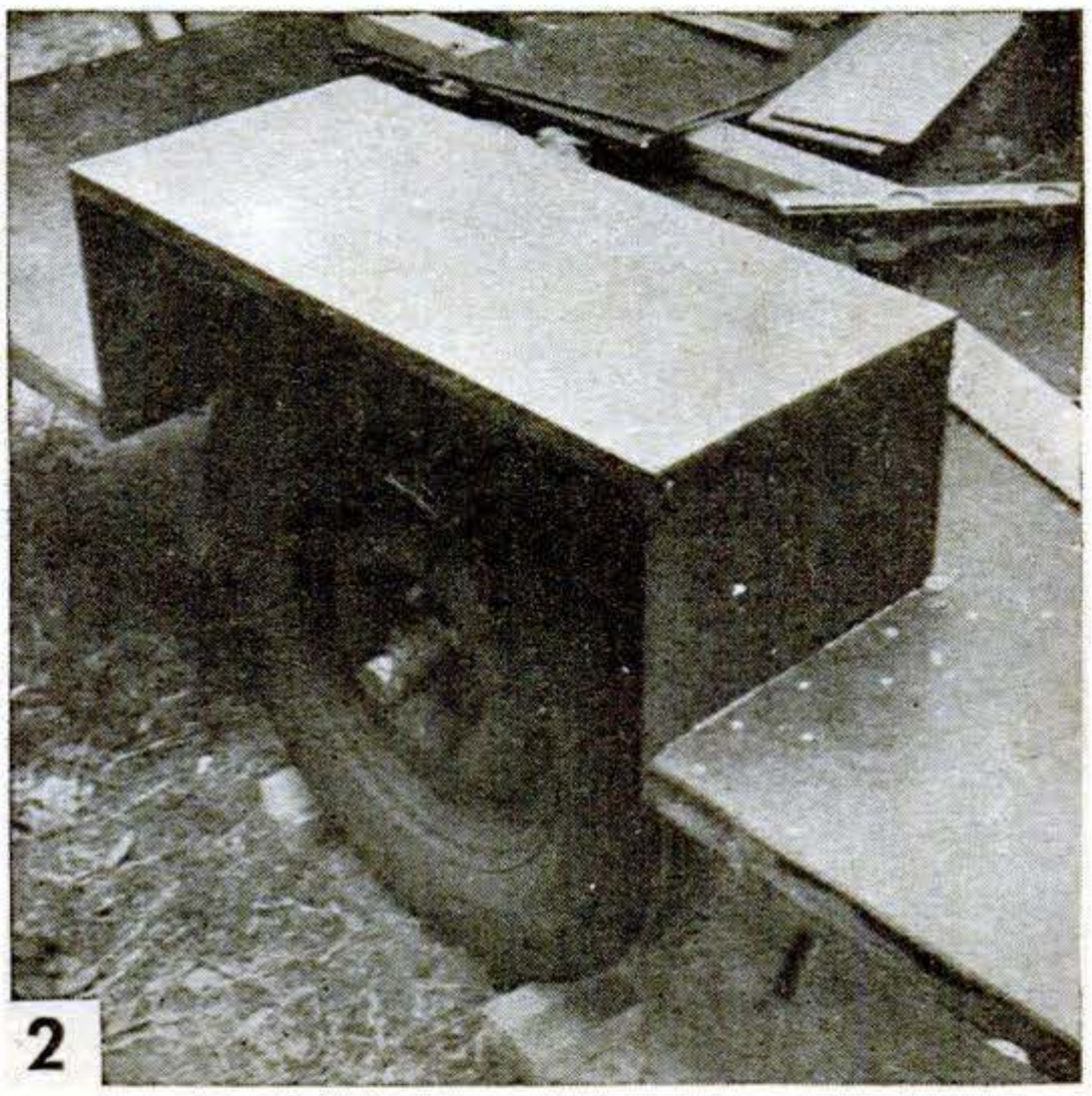

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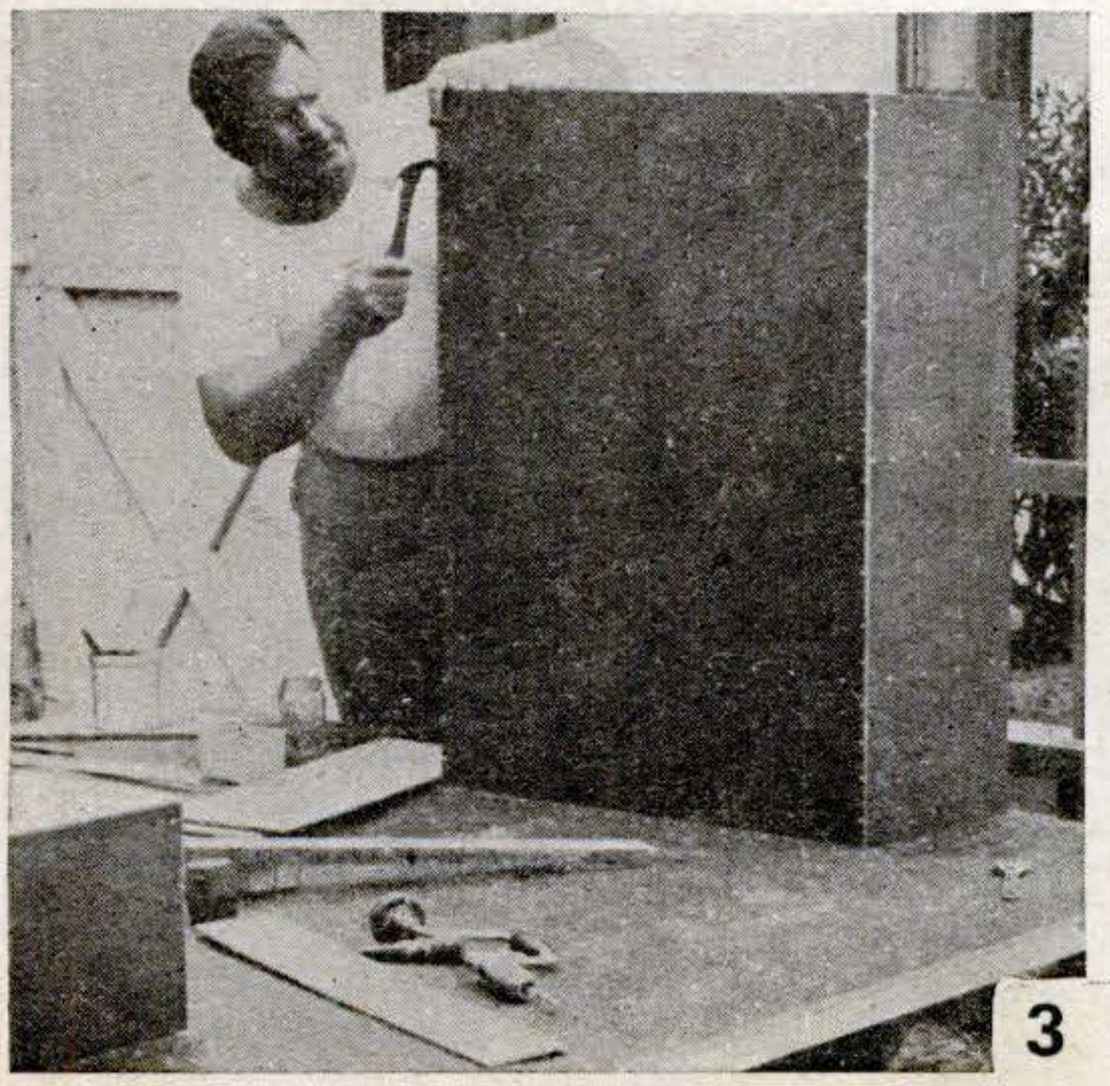
fasten it down, and saw out the wheel openings. Turn the frame over and install the undercarriage assembly. If you have the facilities for welding and metal working, you may be able to assemble a running gear from scrap, or renovate a junkyard bargain. Or you can purchase a complete undercarriage from a trailer-supply house. Figure 1 shows a typical installation.

Using the same ⅜" plywood, build up the housings over the wheels (Fig. 2). The one next to the door is made quite high (Figs. 3 and 8) and will become a sideboard cabinet.

How well the trailer will track will depend largely on the accuracy of the tongue installation, and this, in turn, requires that the axle be perfectly square with the frame. Bolt a pair of two-by-four arms to the hitch-jack combination you have selected, and line up the tongue very carefully before notching and bolting the arms to the first two crosspieces. Assuming that the axle is



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squared, the tongue is aligned when the distance from the midpoint of the hitch ball to the point where one wheel joins the axle is exactly the same as the corresponding distance on the other side.

Side walls are made of ¼" plywood. With the long edges placed together, lay out one 3' by 10' and one 4' by 10' sheet on a smooth floor. Chalk off the surface of the wood into 1' squares with a long straightedge. Transfer the pattern from the squares on the facing page, and fair up the lines with a long strip of flexible wood as shown in Fig. 4. Cut out the pattern with a keyhole saw, but don't spoil the waste you cut off, for this will be needed to make a jig. Using the cut pieces as a pattern, mark and saw the second wall.

Nail together the outline pieces as shown in the foreground of Fig. 5. Cut some scraps of two-by-twos and two-by-fours into 3" lengths, and nail them to the outline edges at 12" to 15" intervals (Figs. 6 and 7). Lay the jig on the ground and fasten to it with shingle nails ¼" by 2" spruce strips from a point a few inches below the front floor line to a few inches beyond the rear floor line. Smear this first strip liberally with thick glue, and nail another strip to it, taking care to stagger the end joints. Continue adding laminations until five thicknesses have been built up. If you have a supply of small clamps, it won't hurt to use them while the glue is setting, but proper fitting and nailing should be enough.

After the glue has dried, hacksaw through the nails that fasten the first chine strip to the jig, leaving the nails right in the wood. Plane the edges until they are flat and smooth. Build a duplicate chine for the other wall.

Haul out the side walls and glue and screw them to the chines. Cut out the door opening on the right side, and save the pieces to make the door (Fig. 8). In the left wall cut an opening of proper size for the window you have purchased.

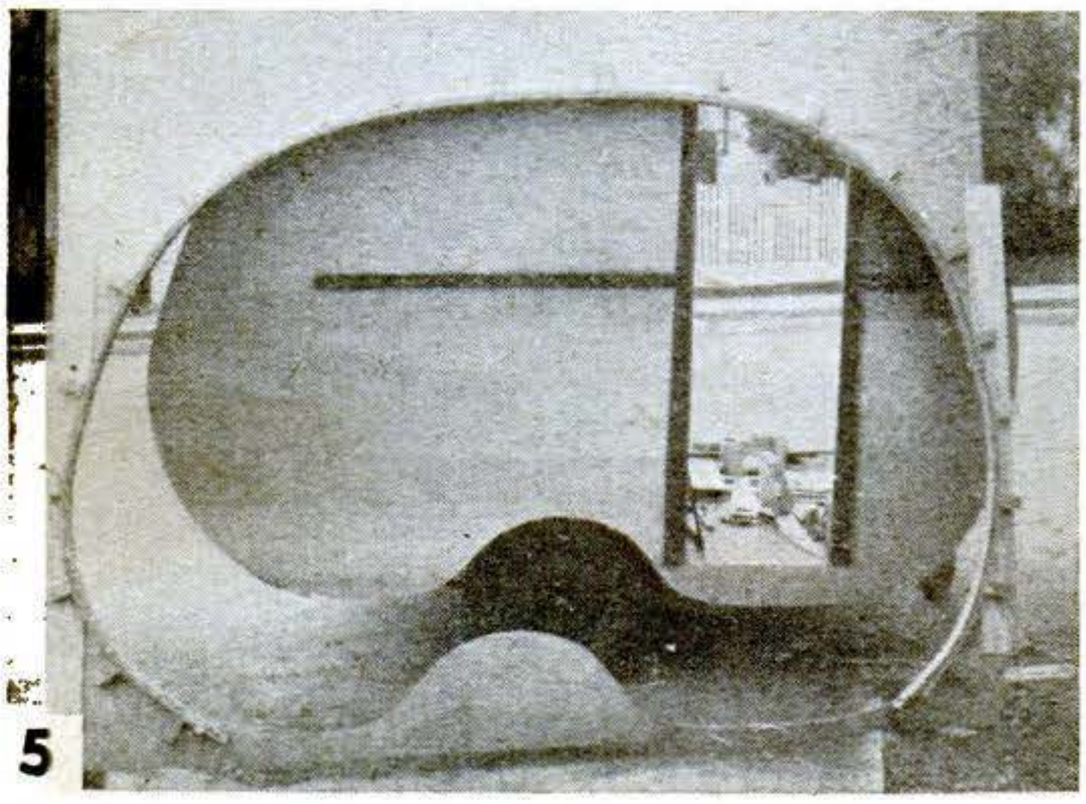
[*To be Concluded*]

LIST OF MATERIALS

1 complete undercarriage, 1¼" or 1½" straight or drop axle; approx. 66" tread. Wheels, tires, and tubes.
V-tongue.
1 window 18" by 24", complete with screen.
2 windows 18" by 30", complete with screen.
6' wire screen 18" wide.
1 roof ventilator approx. 14" sq.
1 stove vent approx. 12" by 15".
1 curved roof jack to fit above vent.
24 flush-type cabinet hinges.
12 flush-type cabinet catches.
1 5-gal. gravity water tank with faucet.
1 25-lb. upright refrigerator.
1 trailer sink approx. 12" by 15" with waste plug and tail pipe.
1 5' combination hinge, continuous type, for door and screen.
2 piano hinges, 1¼" by 6'.
1 complete door lock, left hand.
1 stop and taillight combination.
2 clearance lights.
2 gross 1" No. 6 screws with brass collar washers.
½ gross 1"-13 drive screws.
5 yd. 90" muslin (top).
1 roll felt padding (top).
1 gasoline stove, plate type.
3 electric fixtures with outlets.
100' No. 10 wire.
50' rubber-covered electric cable.
4' 4-conductor rubber-covered cable.
2 4-way male connectors.
1 4-way female connector.
4 lb. waterproof resin glue.
1 gal. spar or plastic varnish.
1 gal. canvas cement.
2 qt. top enamel.
1 mattress 24" by 6'5".
1 mattress 24" by 6'.
2' tubing, ¾" dia.
2 rolls masking tape.
1 box ⅜" copper tacks.
20' rubber seal 3/16" by ⅜".
4' safety chain.
Assorted bolts, nails, screws.

LUMBER

2 pc. 2" by 4" by 16' clear pine, spruce, or hardwood.
1 pc. 2" by 4" by 8' clear pine, spruce, or hardwood.
4 pc. 2" by 2" by 14' clear pine, spruce, or hardwood.
5 pc. ⅜" by 4' by 8' plywood (floor, cabinets).
2 pc. ¼" by 4' by 10' plywood (sides).
2 pc. ¼" by 3' by 10' plywood (sides).
5 pc. ⅜" by 4' by 8' plywood (floor, cabinets).
400' ¾" by 1¼" clear pine, spruce, or hardwood. (studs, cabinets, ribs).
20 pc. ¼" by 4" spruce lattice (roof).
30 pc. ¼" by 2" spruce lattice (chines).
2 maple dowels, ¾" by 4' (front braces).
4 pc. ½" quarter-round moulding, 12' lengths.



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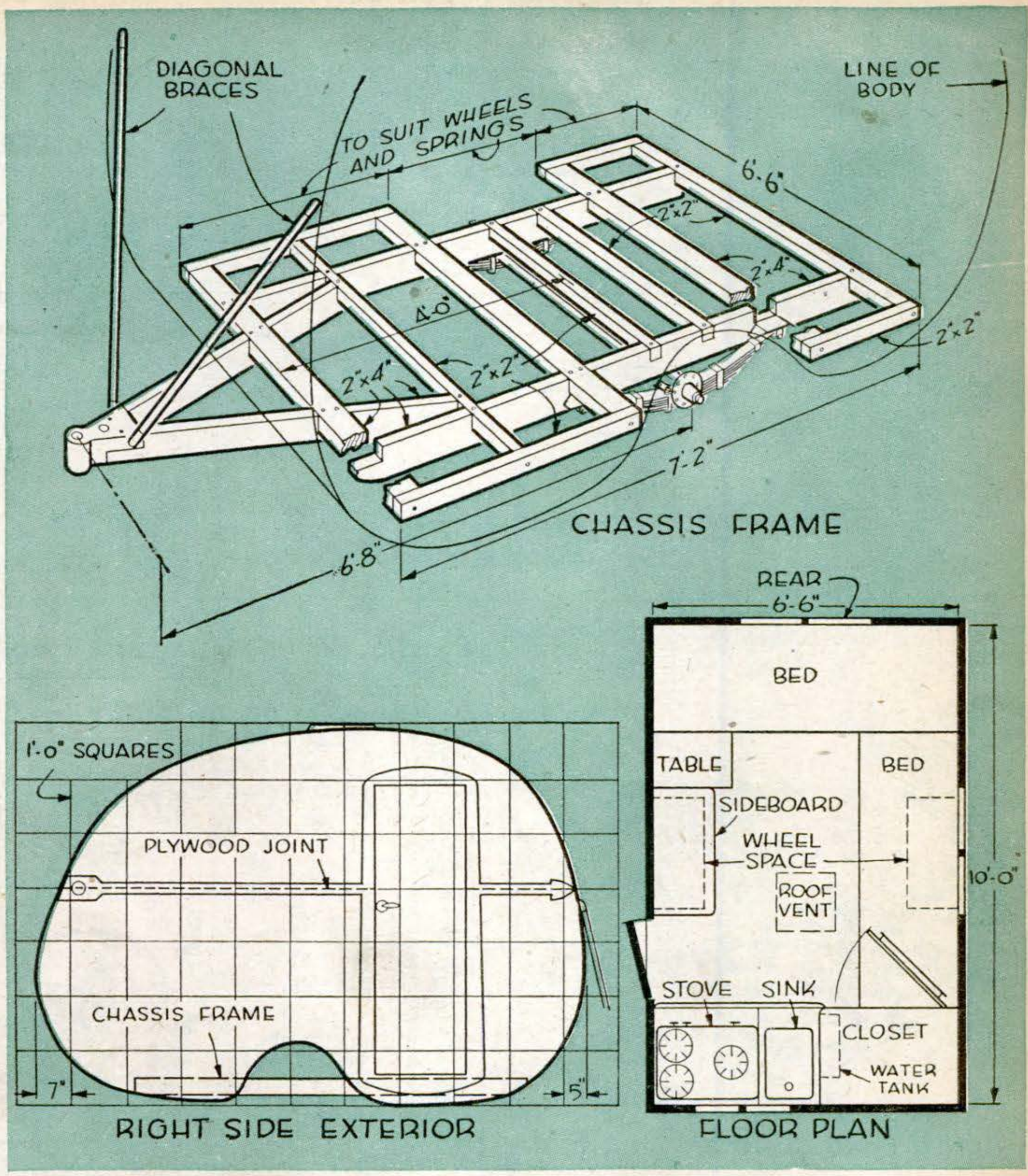

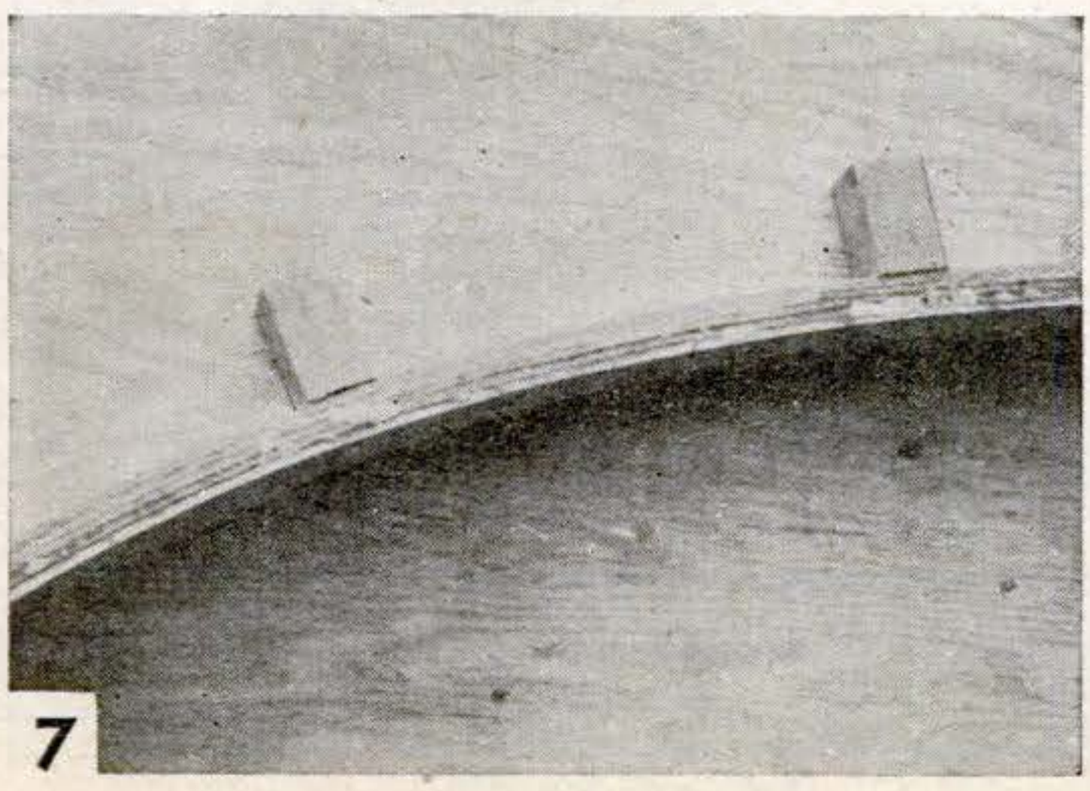

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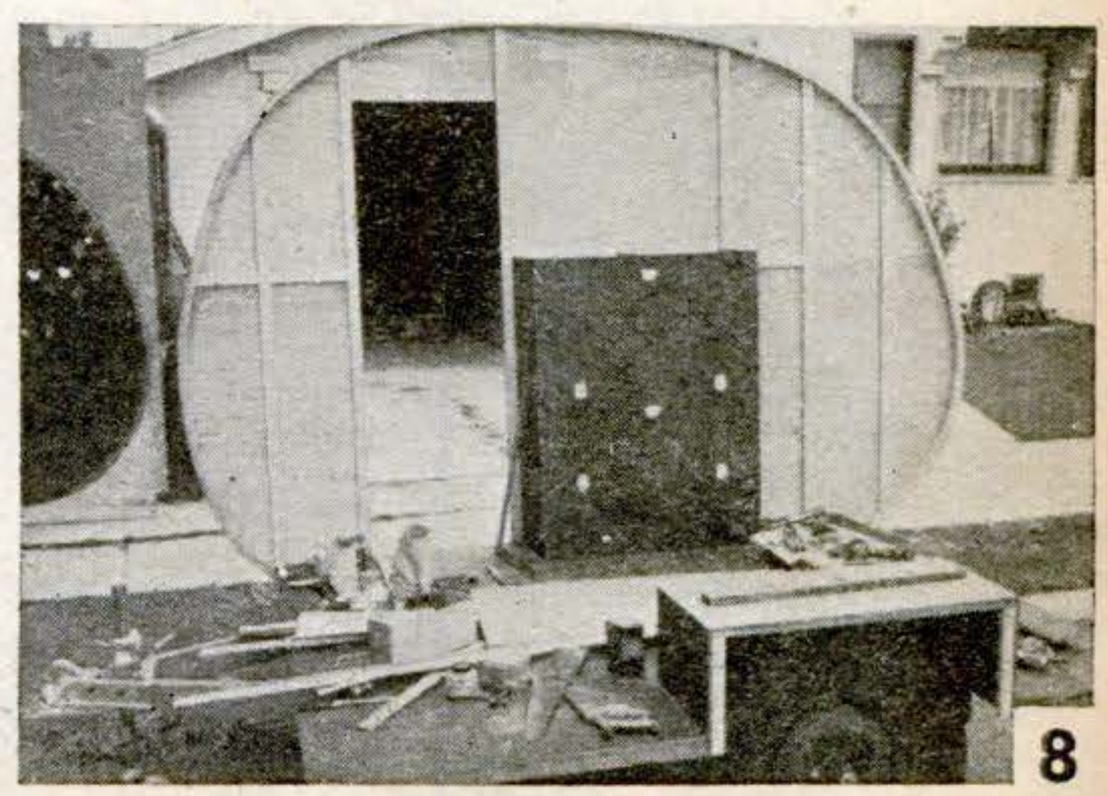

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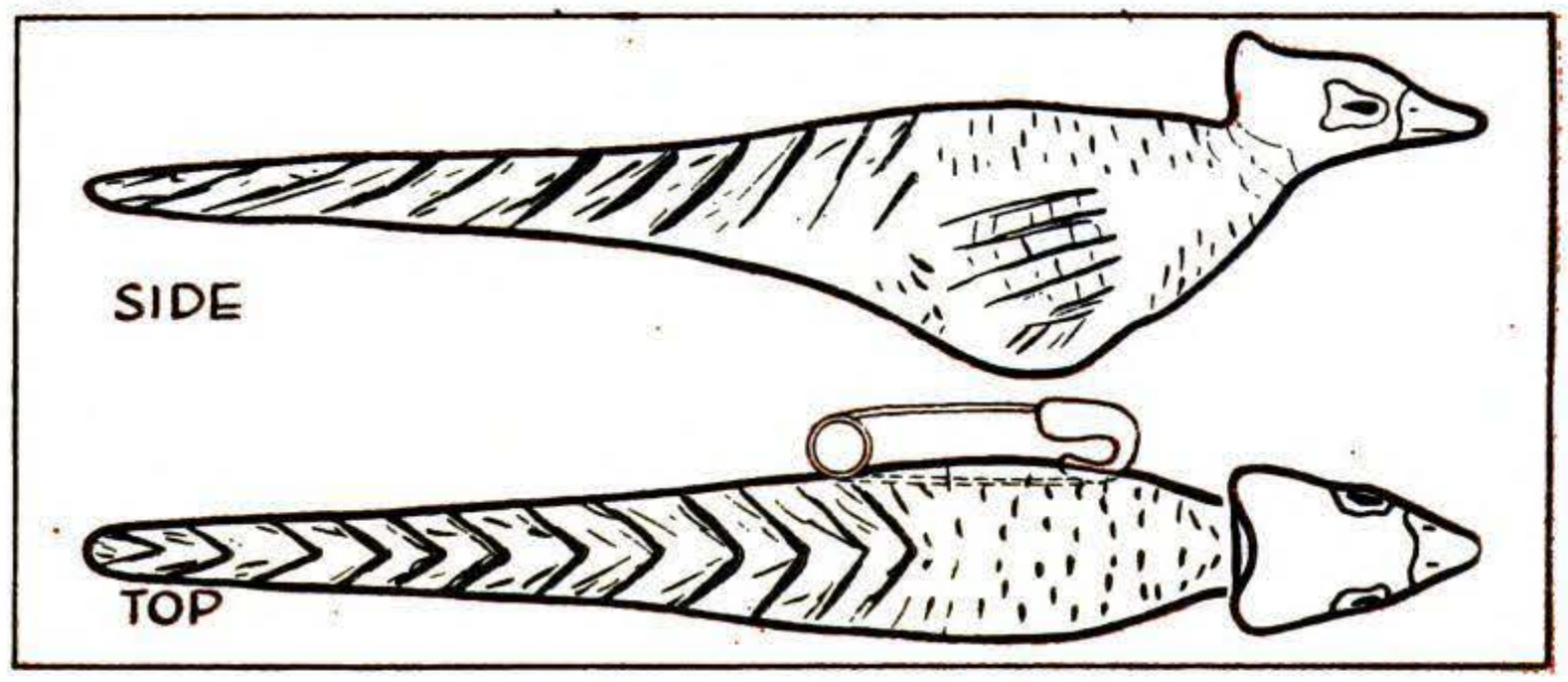
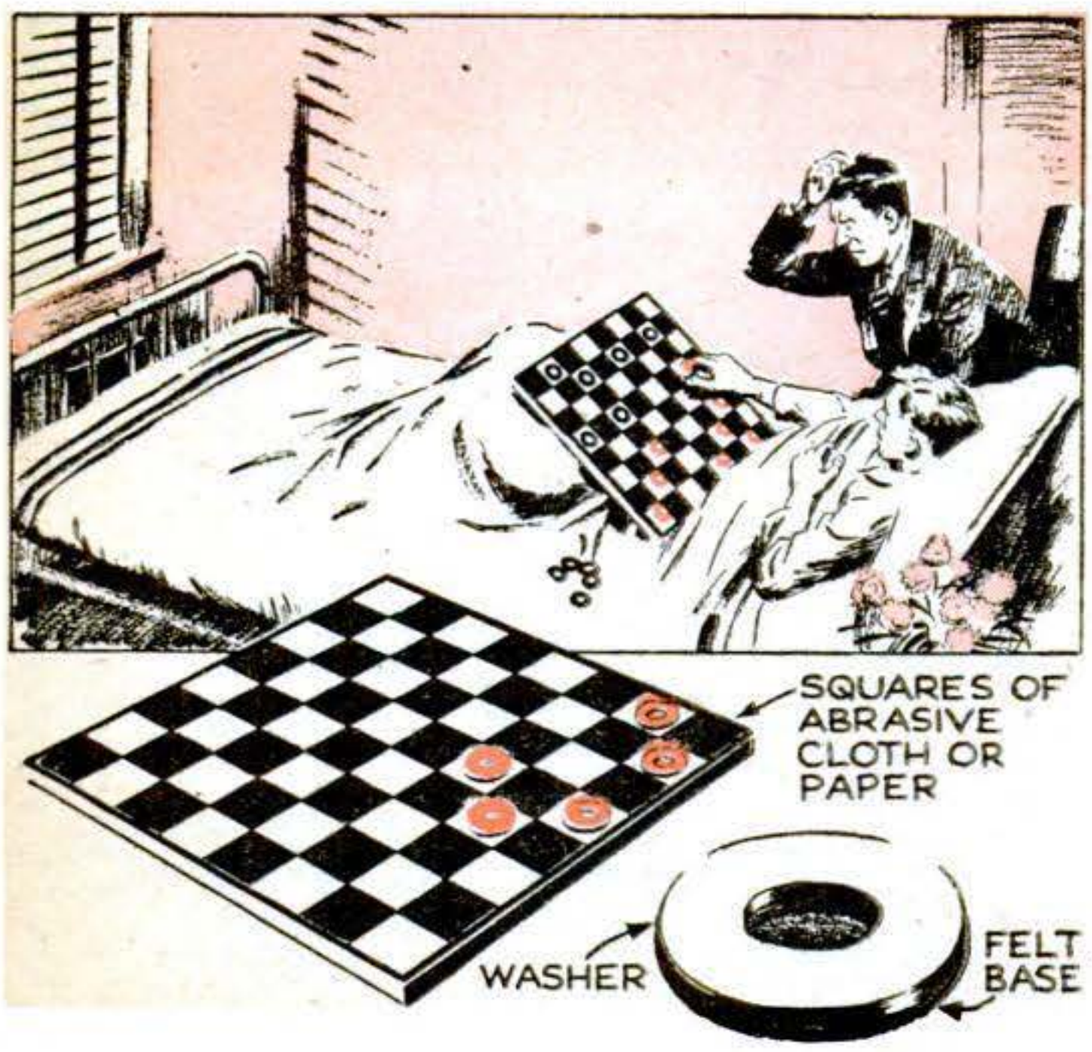
Ringneck Pheasant Carved in Wood Is Unusual Costume Pin

ONE of the most graceful and colorful of birds is the Chinese ringneck, which inspired the pin shown at the left and in a color photo on page 116. Appropriately painted, it makes a pretty adornment for casual wear.

Saw the profile from ½" stock. Round the body and head with a knife next, thinning down the tail and getting the spread of the head. Flatten the back of the body somewhat and gouge out a groove for a small safety pin, which is held with strong glue or cement. Use water colors rather than oils for a feathery appearance.—ELMA WALTNER.





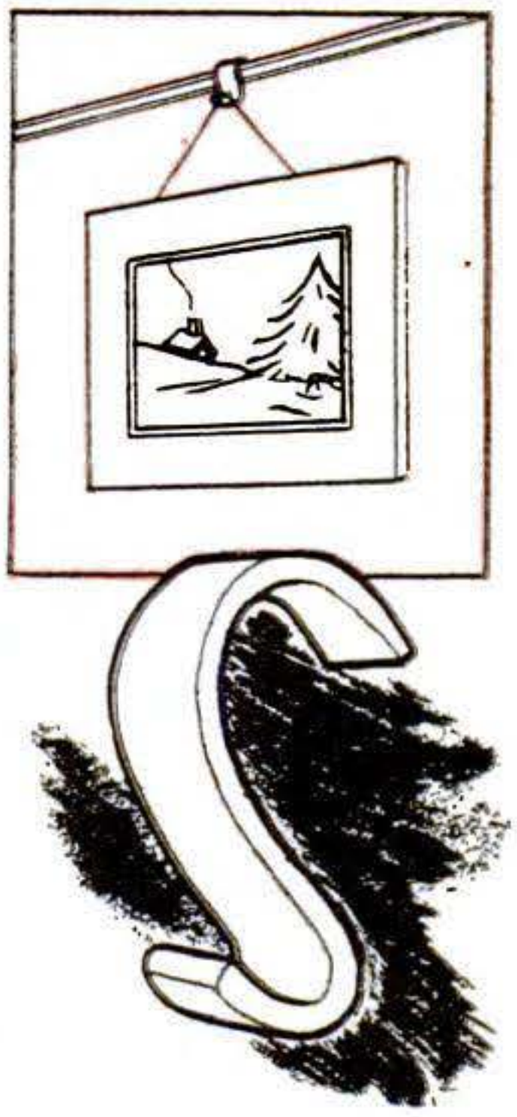
Board Holds Checkers on Slant

SQUARES of coarse abrasive paper or cloth make a checkerboard that bed patients can place at an angle before them for comfortable play. With No. 100 grit it was found the board could be inclined 60 deg. before the checkers fell off. Black squares can be made of carborundum or emery paper and red squares of garnet paper.

For the men, paint washers or disks two different colors and glue fuzzy felt to the bottoms. Since it isn't practical to double men, a few extra should be painted with a gilt ring as kings. For chess, glue chessmen symbols on top of washers. Such symbols can be cut out of a handbook or similar text on chess.—W. E. B.

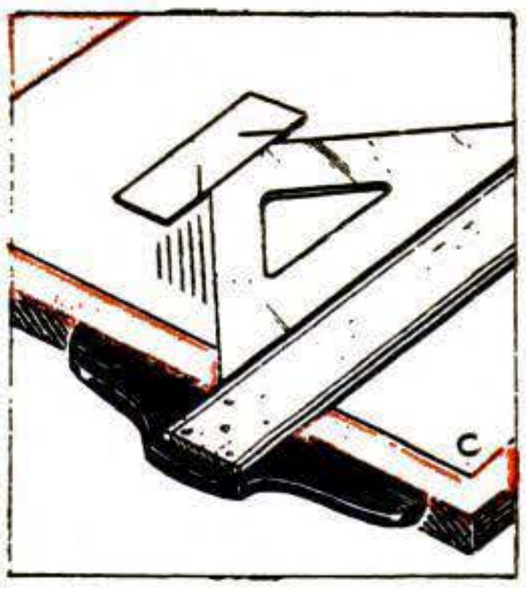
Plastic Picture-Hanging Hooks

STRIPS of lucite or plexiglas ⅛" by ½" by 2⅞" can be bent readily into hooks for hanging pictures on a molding. File the molding end to a bevel and sand all edges smooth; then heat in an oven at 300 deg. F. until the plastic is soft. It can be bent with gloved hands to the shape shown at the right and should be held until it sets. If many hooks are wanted, it may pay to make a simple wooden jig to do the job.—F. S.



Guide Spaces Crosshatch Lines

TAPE marked as at right and fastened to the end of a triangle assures even spacing of lines in crosshatching. A pencil mark on the tape is aligned with the last line drawn, and the pen is run along the edge of the triangle. —A. H. GIFFORD.



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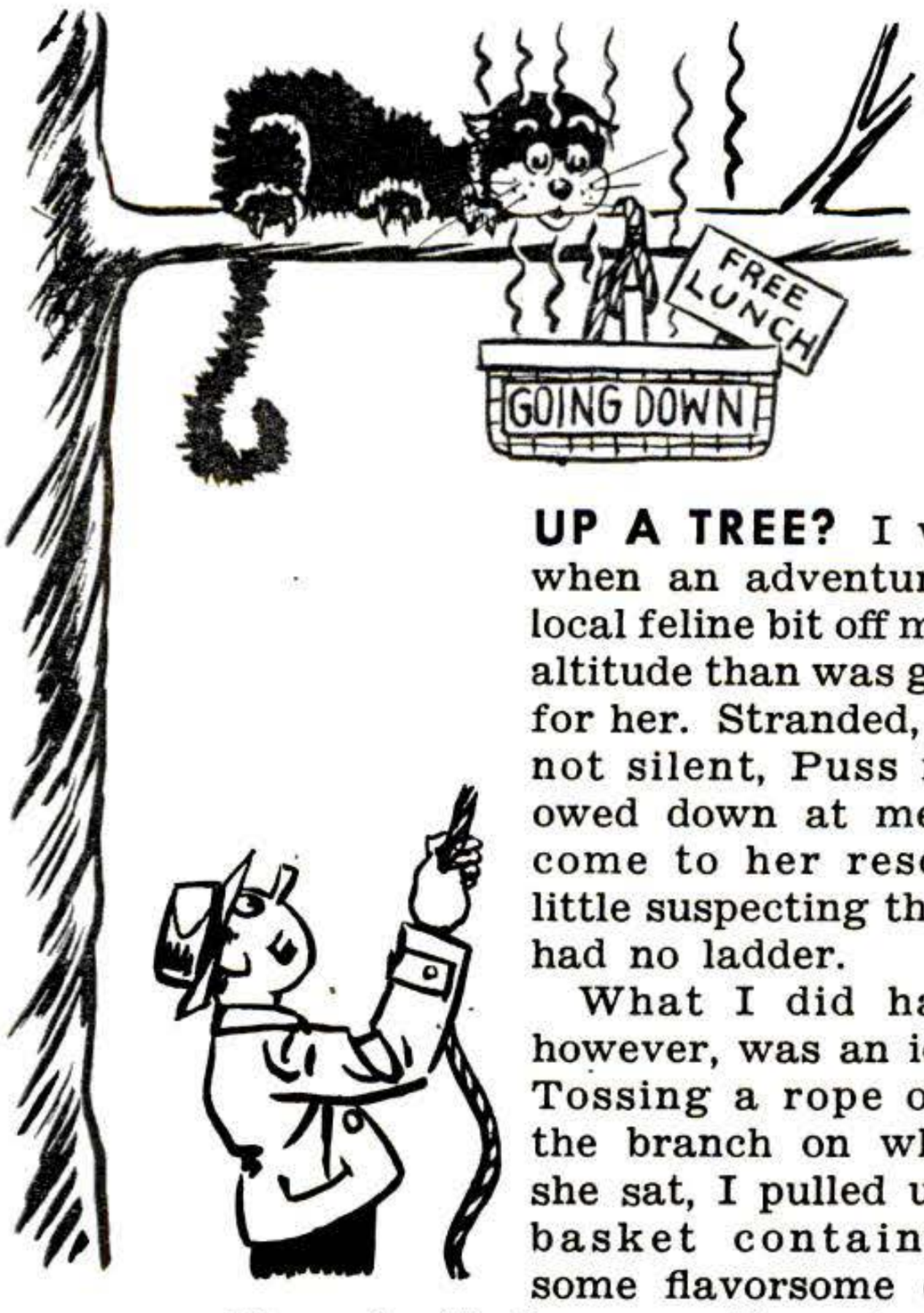
WHAT'S YOUR INGENUITY QUOTIENT?

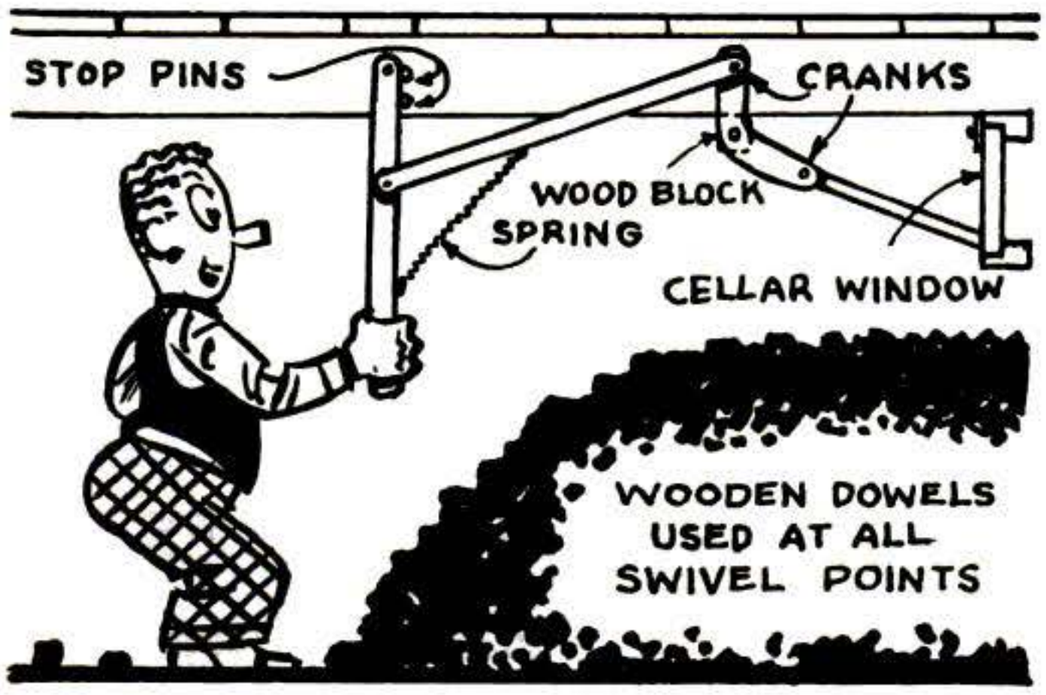
Have you pulled off a smart one lately? We will pay for each contribution accepted for this page showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works.



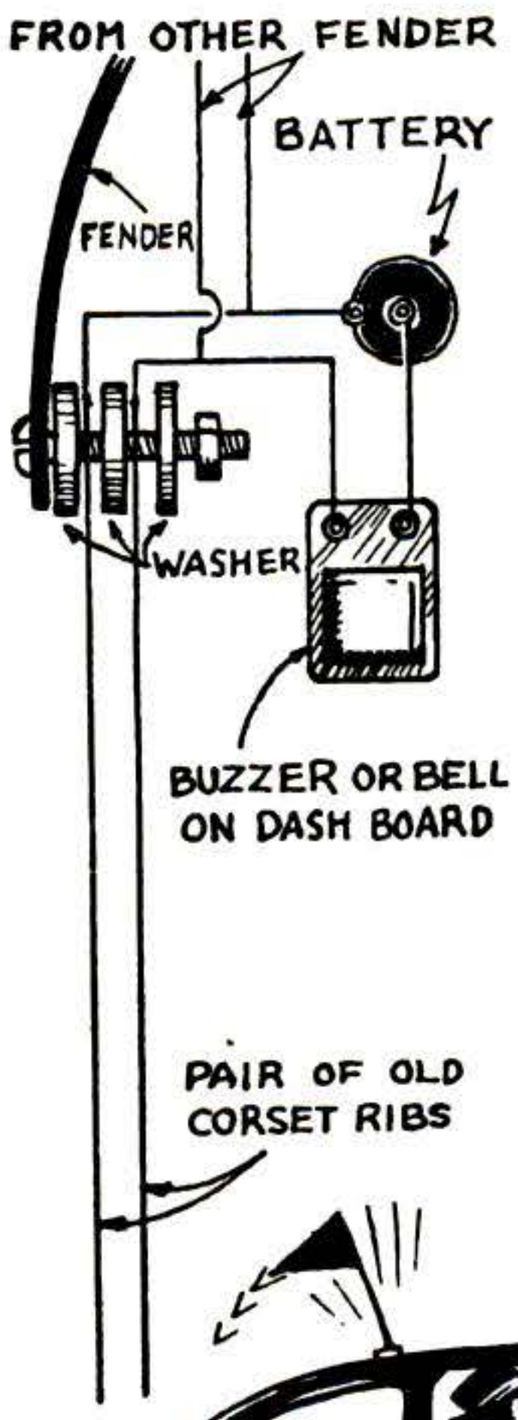
UP A TREE? I was when an adventurous local feline bit off more altitude than was good for her. Stranded, but not silent, Puss meowed down at me to come to her rescue, little suspecting that I had no ladder.

What I did have, however, was an idea. Tossing a rope over the branch on which she sat, I pulled up a basket containing some flavorsome cat-supper. Pleased with the menu, Puss stepped aboard this improvised elevator and I lowered her to *terra firma*.—JOSEPH MARCUS.

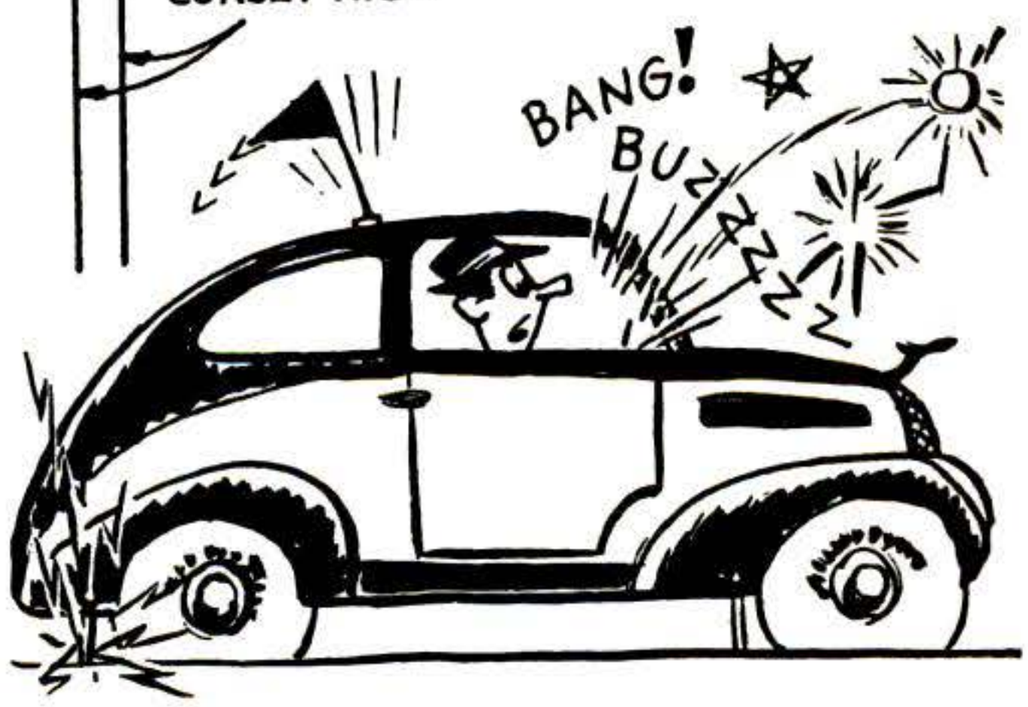
IT'S COAL DOWN HERE that kept me from opening and closing my cellar window. Ventilating my basement used to mean a dirty scramble over the coal pile—with a second scramble later on to close and lock the sash. Being a lover of levers, I rigged up the system shown below. Pulling the handle opens the window. The spring holds it that way until I've had enough air. Pushing the handle forward thereupon closes the window, and the lever action holds it locked against pressure from outside.—GROVER C. RICHARDS.



TIRED TIRES that kept threatening to go to sleep on the job made me wake up. Every time I scraped my tires against a curbstone, I could feel another ounce of life oozing out of their weary rubber carcasses. "Where there's a tire shortage, there's a way," I told myself. And sure enough, there was.



A pair of metal corset ribs, scraped bare on one side, made a long, flexible switch for each wheel. Fiber washers and oversize clamping holes prevent contact along the bolt. With the switch bolted to extend a little outside each tire, I have an advance signal that warns me if I drive too near the curb in parking.—J. M.



I FORGOT TO REMEMBER MY REMINDER once too often before I decided to put the day's memoranda under lock and key. My search for the place I couldn't possibly miss seeing ended with the lock on the inside of my front door. Now I'm all set to take care of the day's tasks as soon as I leave the house—provided, of course, that I don't misplace the slip. Another way might be to clip the list to my car-key holder.—G. BARR.

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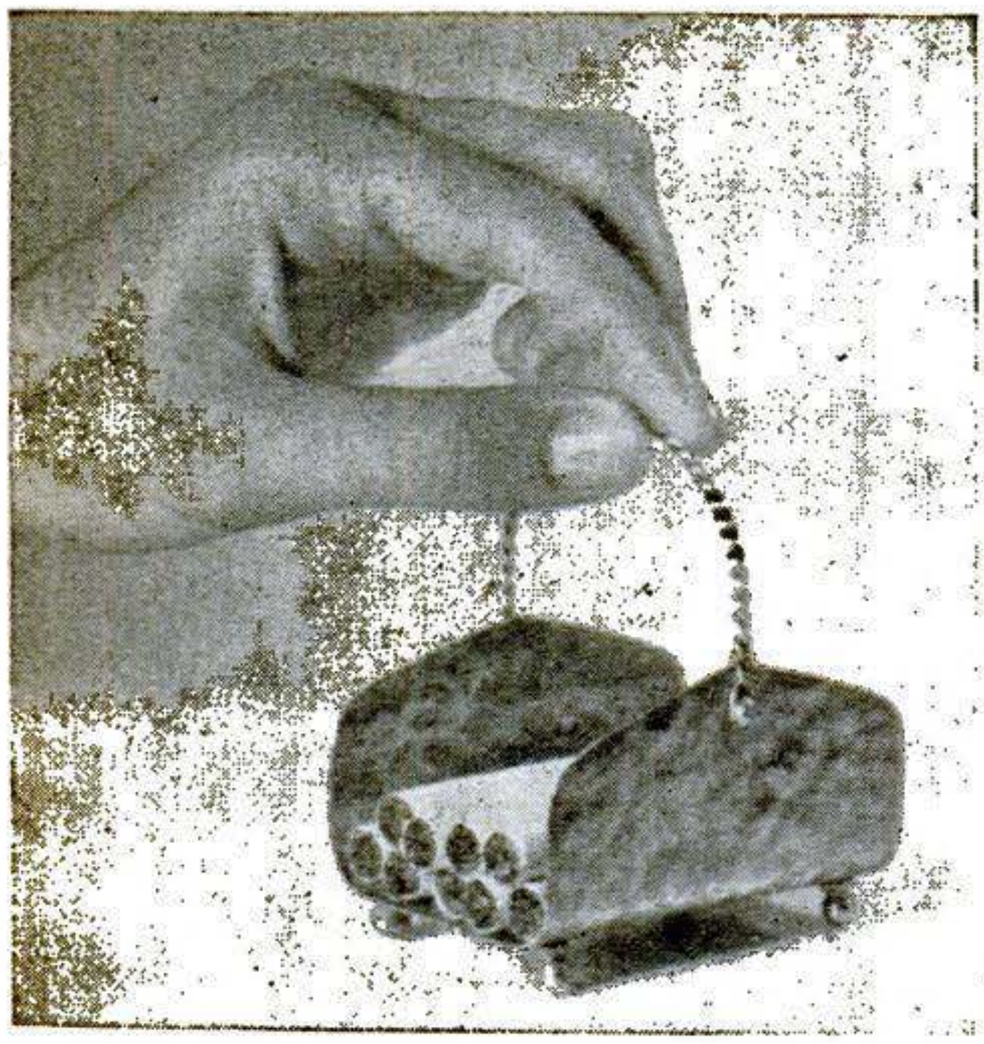
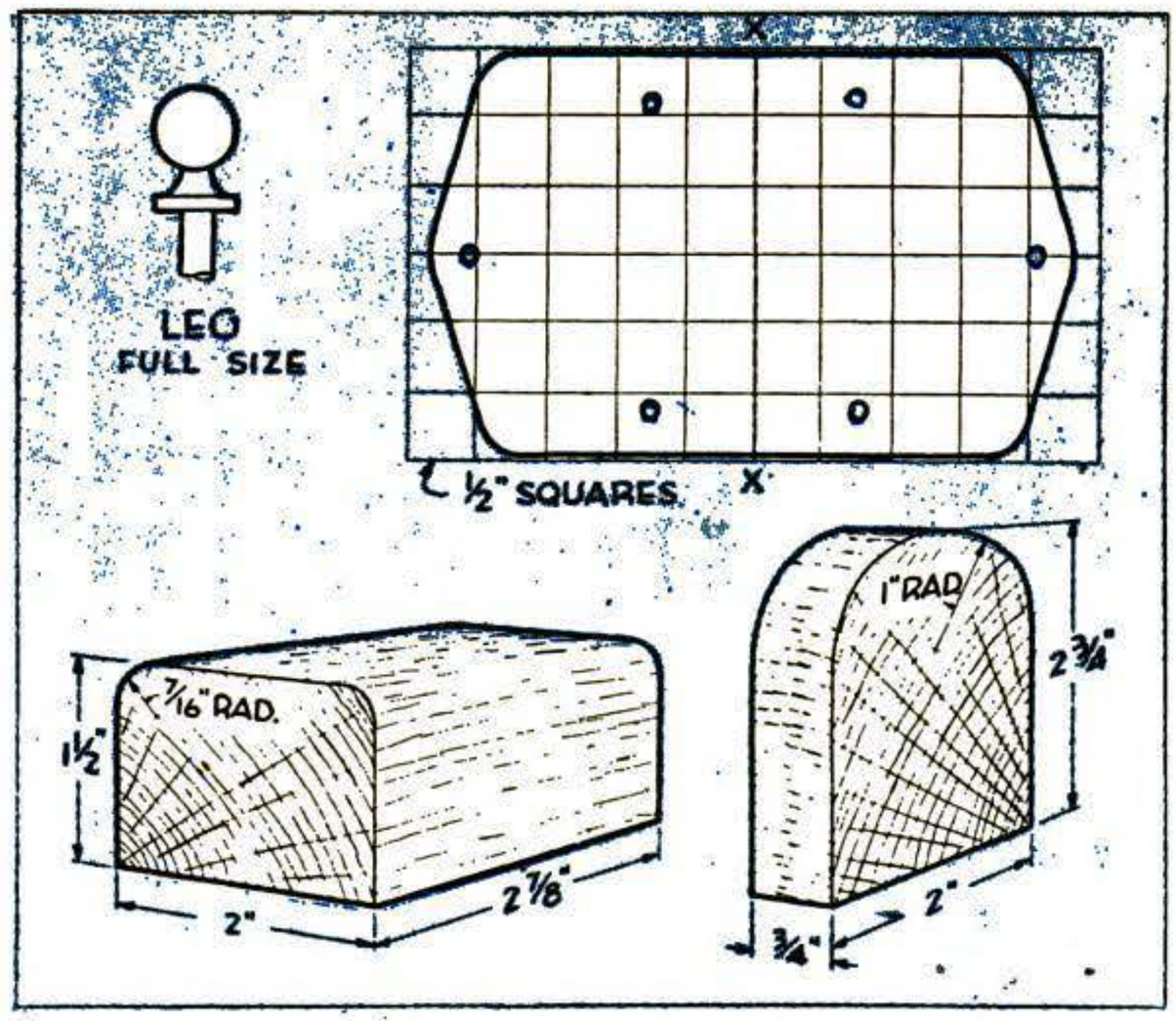
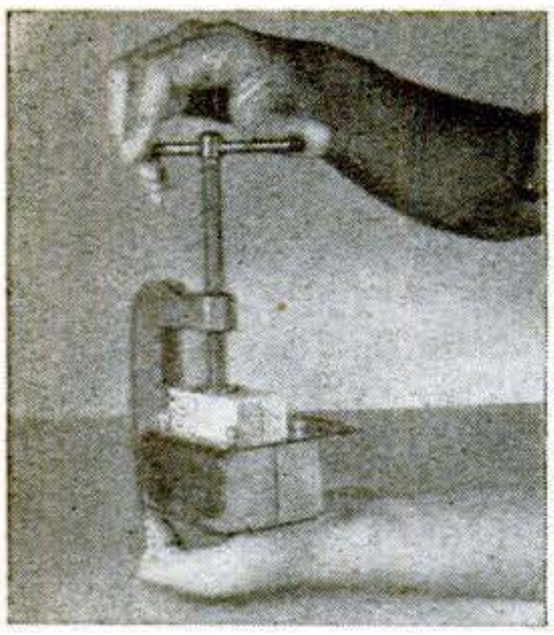
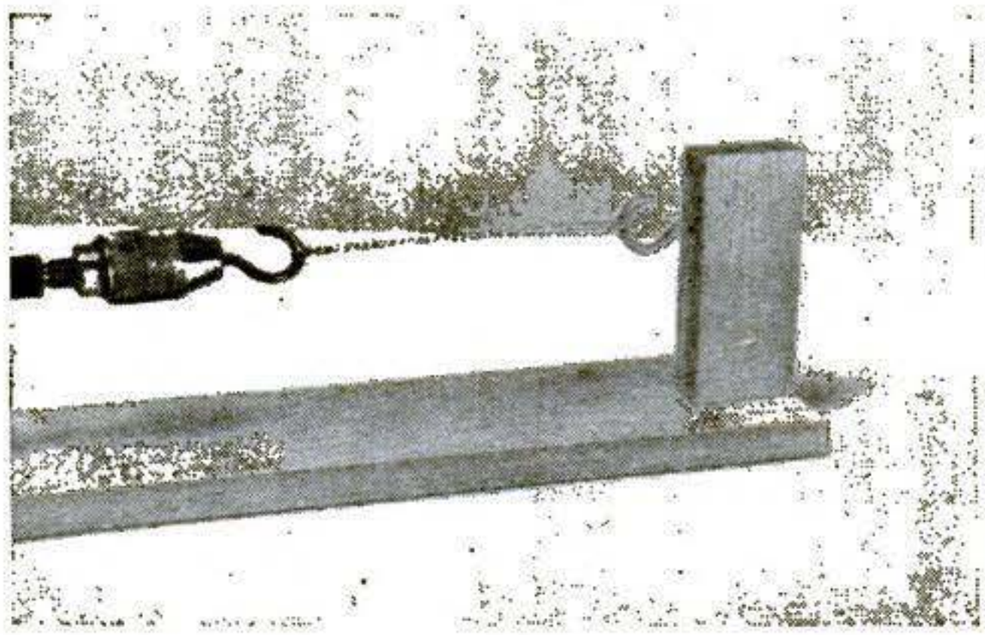
Hammered-Metal Cigarette Container Resembles Log Carrier

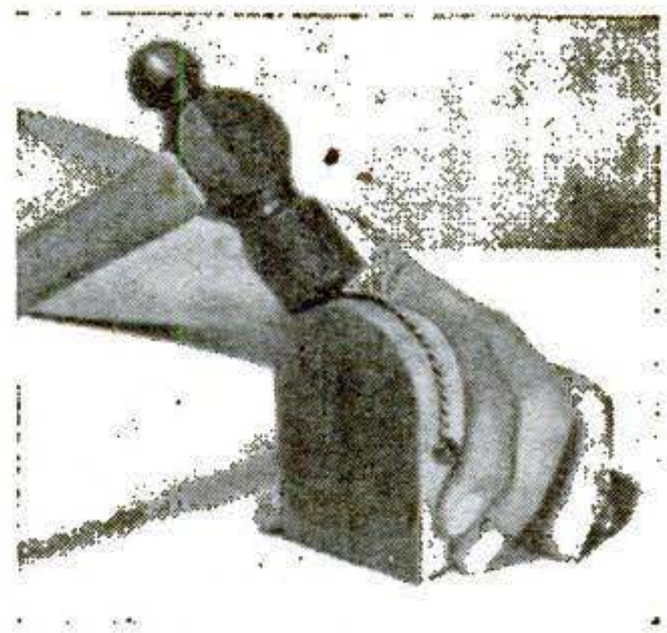




One of the two wooden forms shown in the drawing above is used for bending the body, as at the left below. The other is for the handle, lower right. Center, a loop of wire is twisted with a drill for the handle.







A MINIATURE version of a fireside log carrier, this cigarette container is shaped by means of two wooden forms. Once you have made the forms, a number of the little holders can be turned out with little effort as gifts for your friends.

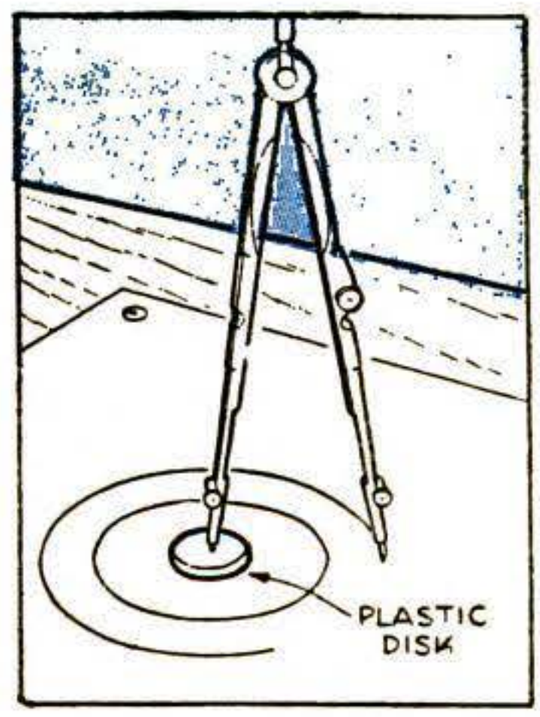
Cut the body from sheet copper, drill holes at the points indicated on the pattern, and then hammer the metal to produce a decorative effect. If a lathe is available, legs may be turned, but in this particular case hinge pins were used, the shanks being cut off and the legs then riveted to the body.

Shape the body between two wooden blocks held in a C-clamp, the lower block being one of the two wooden forms. Align the work by means of a line *X—X* scribed on the metal and others on the ends of the blocks.

A wire handle with an eye in each end may be twisted with a hand or breast drill as shown in the center photo above. Loop 9½" of wire around a hook in a block of wood and another in a drill chuck, twist the ends together, and turn the drill. Now bend the twisted wire around the second wooden form, as shown above, fasten the eyes with screws, and hammer the wire against the wood. Also clip off the ends where the wire is joined and file them smooth. Attach the handle by means of rivets.

Burnish the completed container with fine steel wool and coat it with lacquer to prevent tarnishing.—BERTRAM BROWNOLD.

Plastic Holds Compass Point



WHEN circles are being drawn, the compass point can be kept from piercing the paper and board if a disk of plastic or celluloid is used as shown here. Apply rubber cement to one side of the disk, let it dry until tacky, and then place over the center point.—M. A. J.

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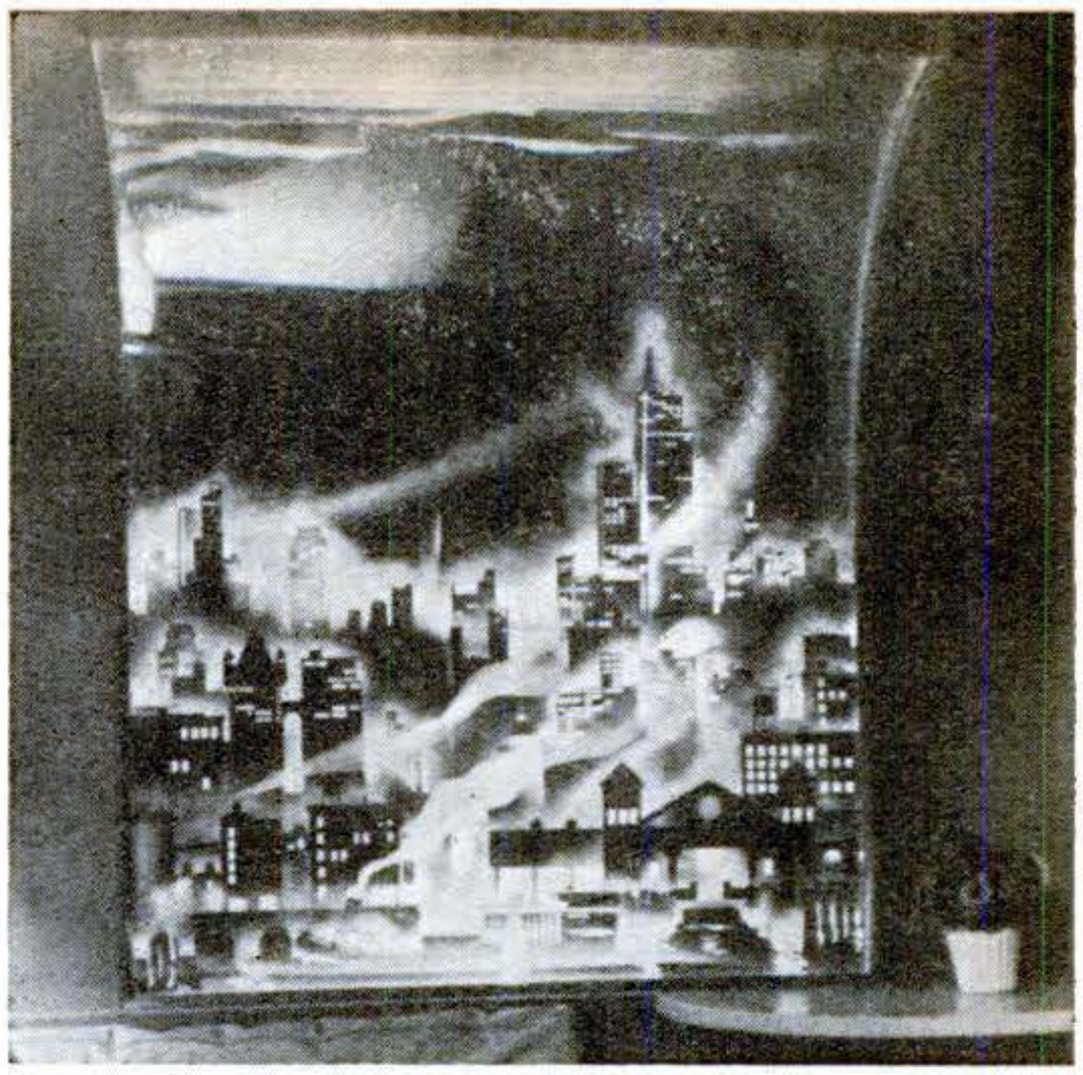
HOME OWNERS

PLASTIC HOMES? That seems to be an intriguing possibility for the future, for the Rohm & Haas Company, makers of clear acrylic plastic, and Sylvania Electric Products now are exhibiting a three-room plastic apartment. Consisting of a bedroom (right) with a mural in light, a dressing room (lower right), and a bathroom (lower left) with a turret-shaped shower, the suite is illuminated by fluorescent lamps placed to edge-light the plastic walls. Passing through the plastic from edge to edge, this light causes the walls to glow radiantly where engraving interrupts the normally smooth polish of the surface, providing both decoration and illumination.



SAGGING FLOORS may be raised to their original level and given permanent support with a steel post manufactured by the Tel-O-Post Company, of Akron, Ohio. Consisting of two telescoping sections with a built-in screw jack, the post is adjustable to fit any basement between 5′7″ and 8′4″ in height. Laboratory tests made by the manufacturer have shown that the post will support a weight of more than 20,000 lb. in complete safety. After the post has been placed under a sagging beam, the jack bar is given a half turn each week to raise the floor safely to its proper position.

CLINKER REMOVAL has been simplified by Carl Anderson, of Bloomington, Ill., through invention of the swivel scoop that he is shown holding below. It is designed to follow the inner contour of the fire bowl when the curved handle is properly manipulated.

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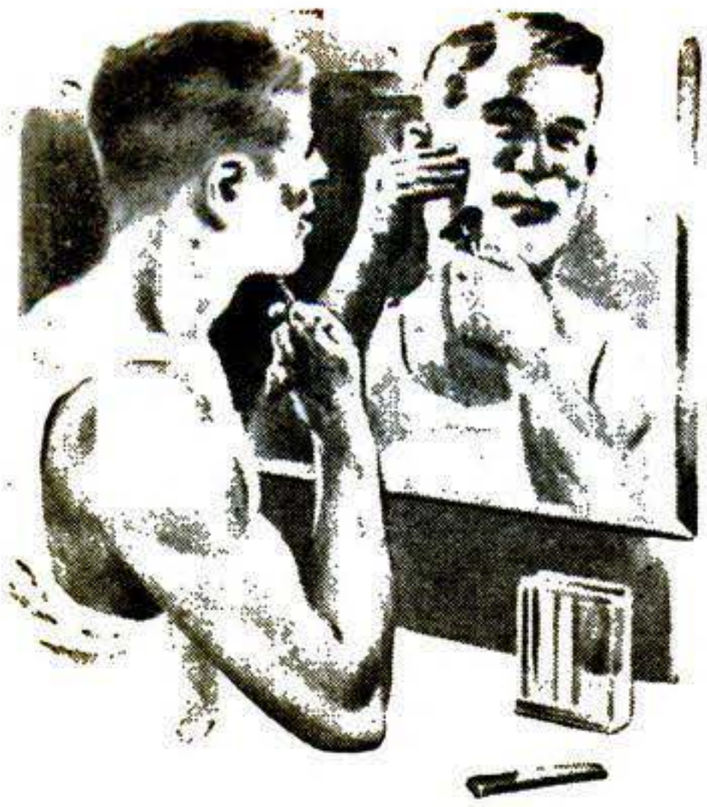
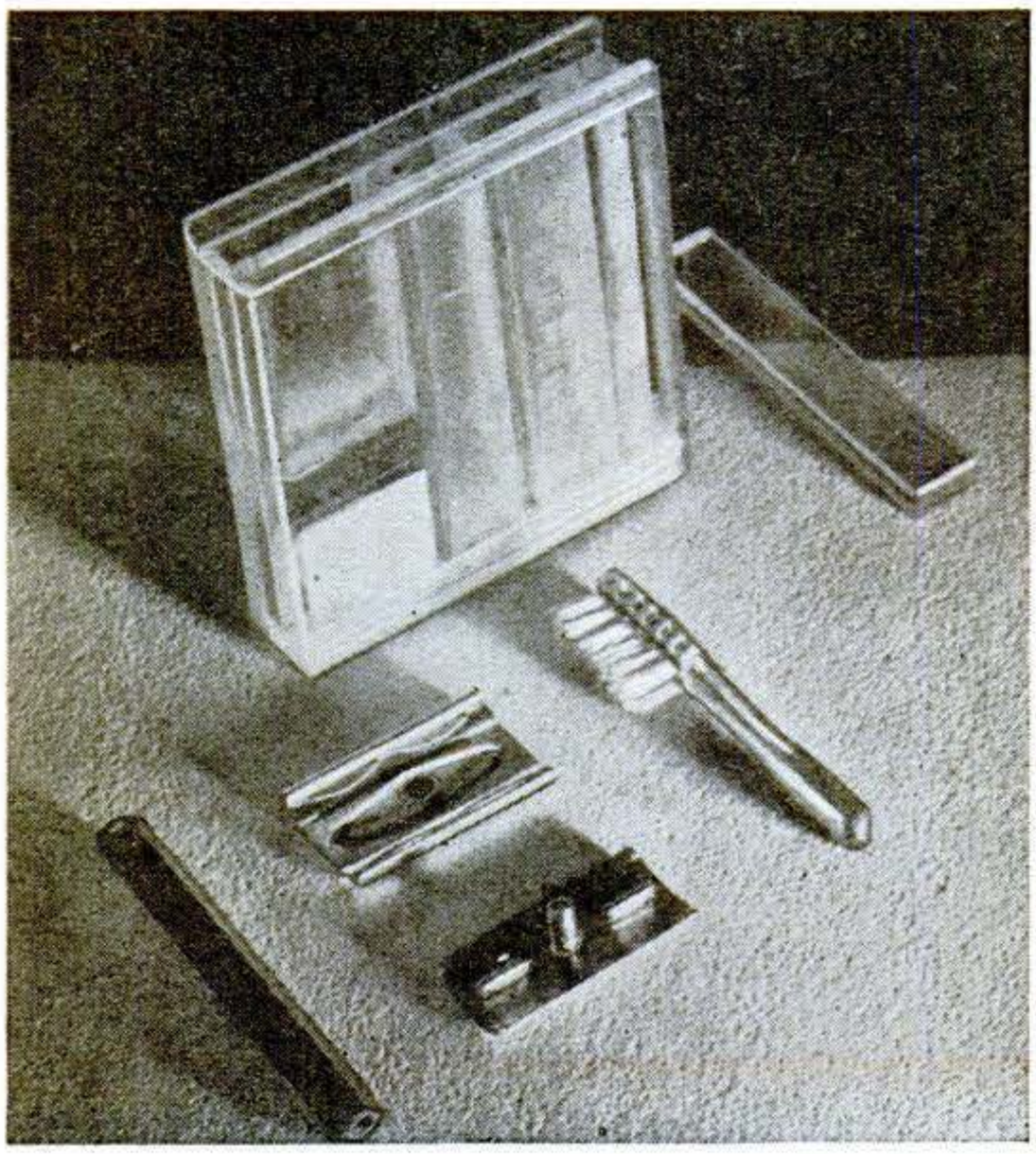
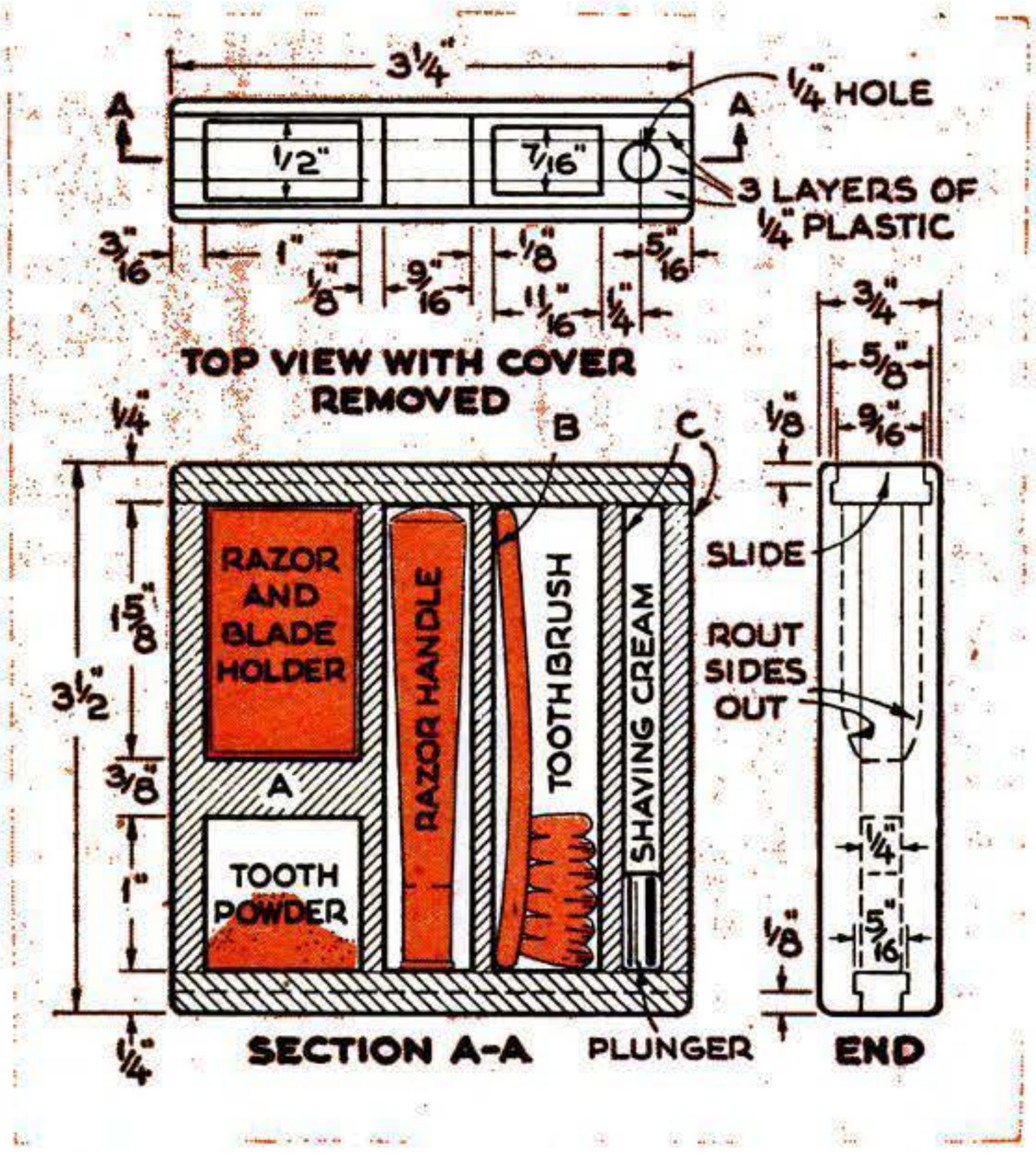


Plastic Week-End Kit Fits into Coat Pocket

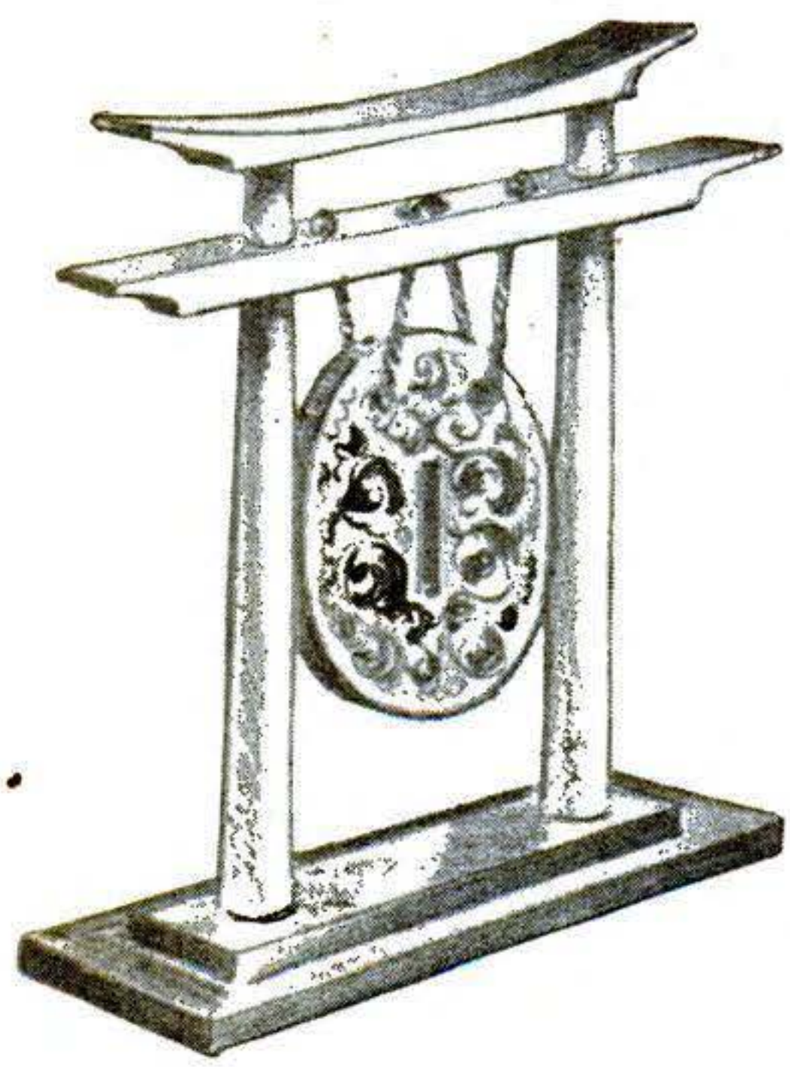
DROP this plastic kit into your coat pocket and you're all set for a week-end trip, if, like me, you prefer to travel unburdened. I have used the kit on many short jaunts away from my Army post to carry a razor, a short-handled toothbrush, brushless shaving cream, and tooth powder.

Three layers of ¼" plastic were used to make the kit. The three parts *A*, *B*, and *C* of the center layer were cut on a bandsaw and polished smooth. Extra compartment space and the slide grooves were formed in the two sides with a router bit, as were the slides themselves. After the parts were cemented together, a ¼" hole was drilled in *C* to hold shaving cream. The plunger is pushed with a pencil to force out the cream.—RAY JANSMA.





Display Stand for Japanese Sword Guard



SAMURAI sword guards, many of which are being brought home as souvenirs, frequently are beautiful examples of metal carving and gold and silver inlay. This stand will display such guards to excellent advantage, for it is a miniature torii—one of those gateways commonly found at the approaches to a Shinto temple in Japan. Black lacquer for the base, vermillion lacquer for the rest of the stand, and a bright yellow cord for suspending the sword guard will provide a good color scheme.—C. W. B.

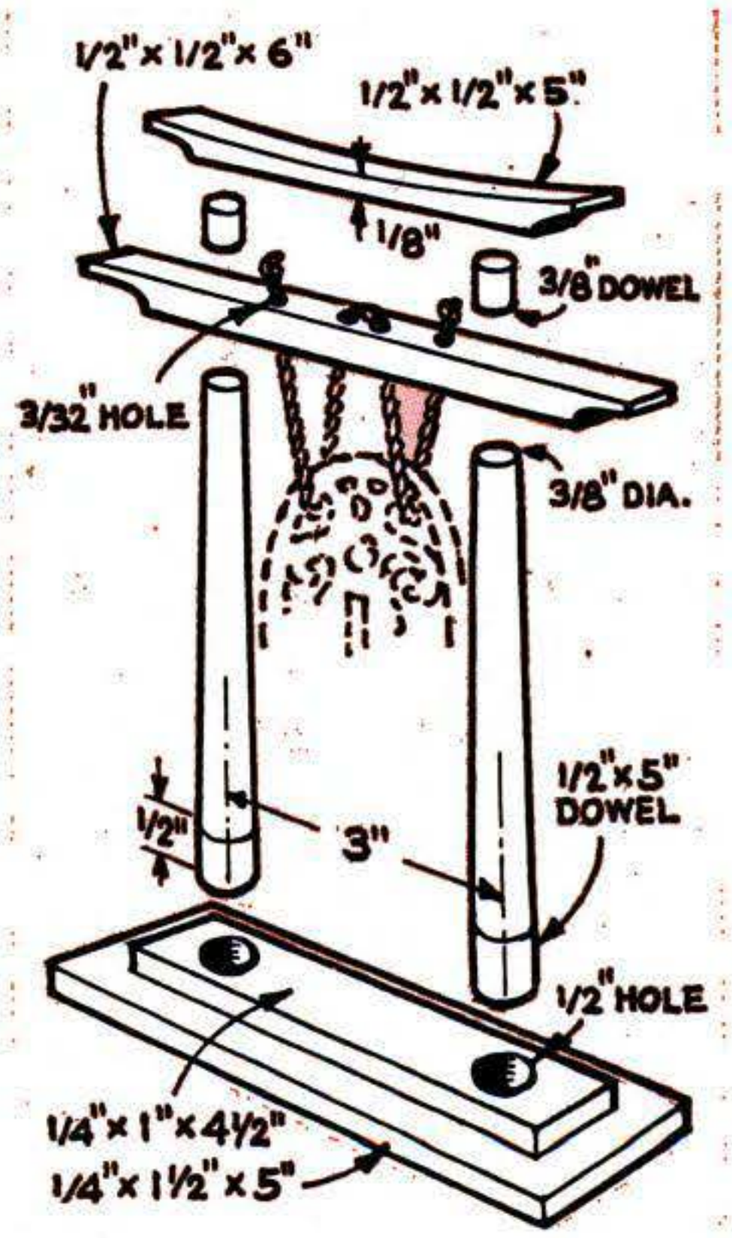


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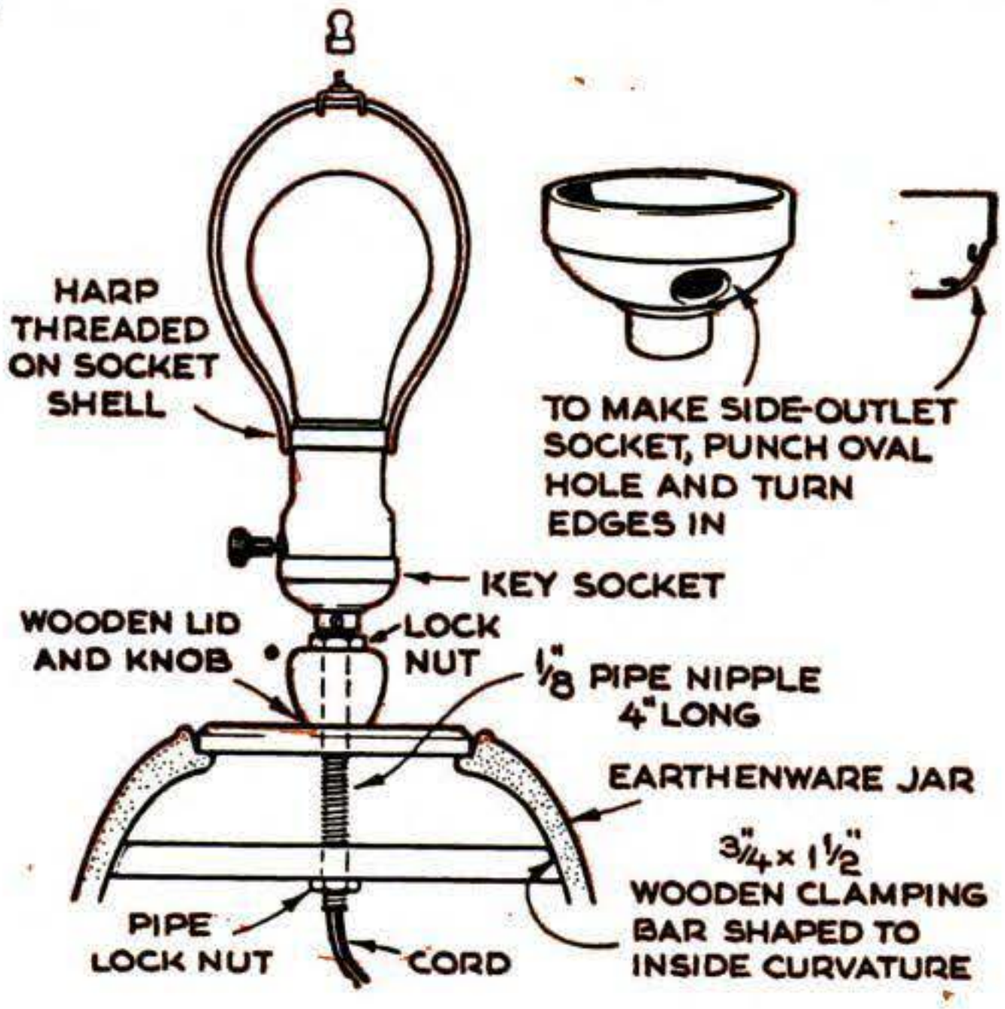
Table Lamp Made from Bean Pot Is Decorated with Decals



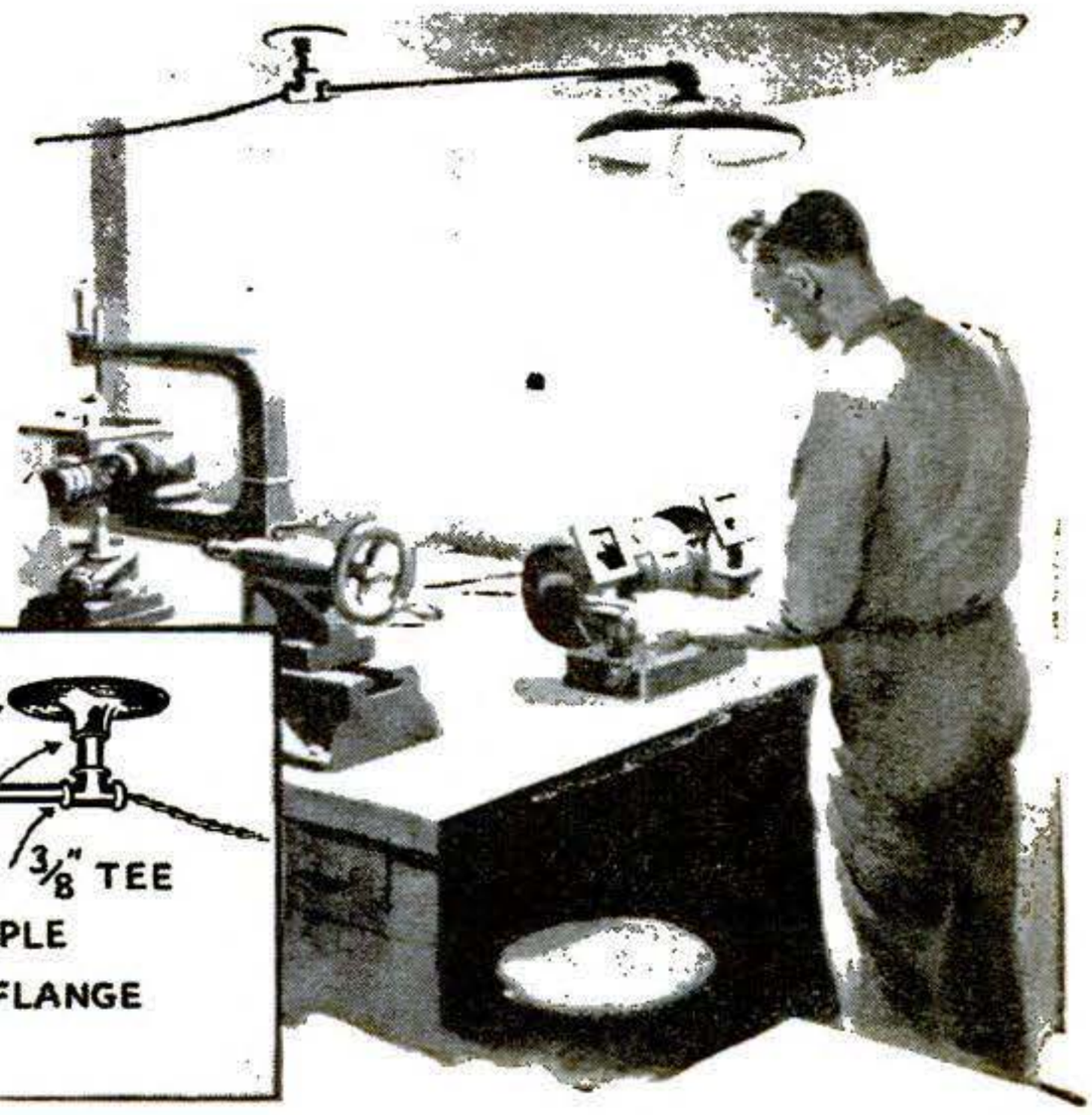
A GOOD project for ornamentation with the smaller decals in Colonial or Pennsylvania Dutch motifs is the bean-pot lamp shown above and in full color on page 116. To avoid drilling through the thick earthenware knob and lid, this part was discarded and a duplicate made of wood. All edges were softened with sandpaper to simulate the original lid, a 3/8" hole was bored through, and the piece was given two coats of mahogany enamel—not stain or varnish—which proved a good match for the jug.

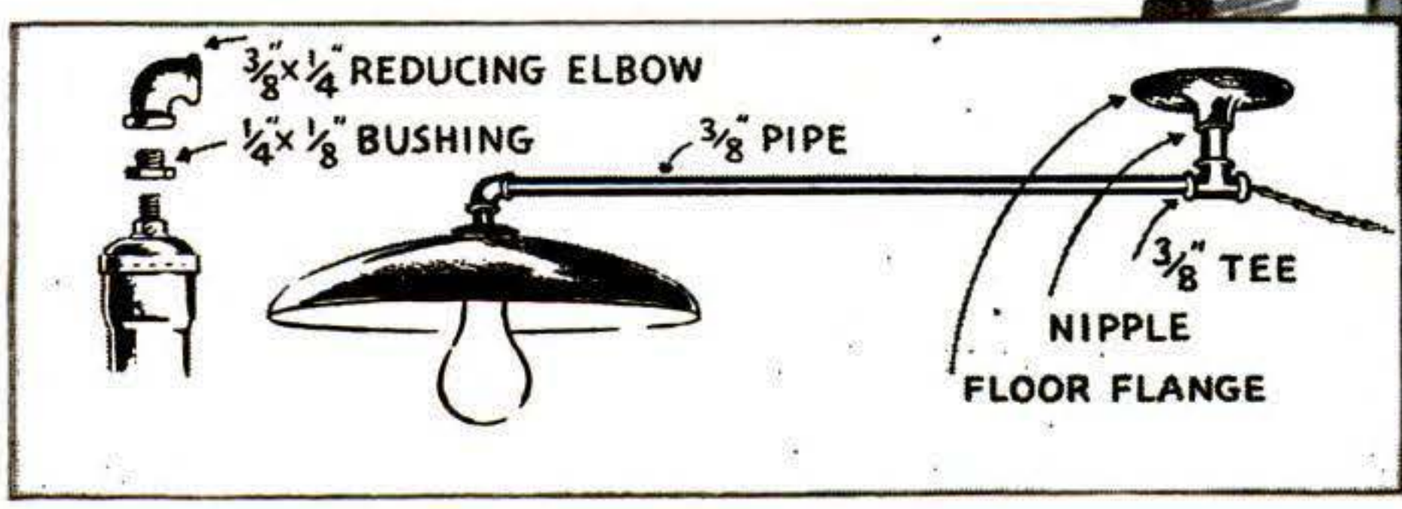
By means of a 1/8" pipe nipple and two lock nuts, the lid was clamped on its seat against a wooden piece shaped to fit the inside of the jar, as shown in the drawing. In assembly, the lamp cord was passed through all the parts and knotted under the clamping bar so as to hold this piece up while the lid was fitted over the nipple.

To bring the cord out at the side of the jar near the bottom, a hole was drilled in the pot with a 3/8" brass tube and coarse valve-grinding compound. This drilling can be avoided by use of a side-outlet socket, which can be made as shown above if not readily available. A lamp-clip shade may be used instead of the harp.—H. W.

Overhead Bench Lamp Swings on Pipe Flange-and-Nipple Pivot

WHEN several machines are grouped, a pivoted ceiling fixture that swings from one to the other will provide light where it is most needed. The pivot is made from a floor flange and nipple. A tee, a section of pipe of the required length, and a reducing elbow make a swinging arm on which the lamp socket and shade are mounted. The arm swings on the nipple threads. Ream all openings to protect the wire.—H. M. CHILDS.





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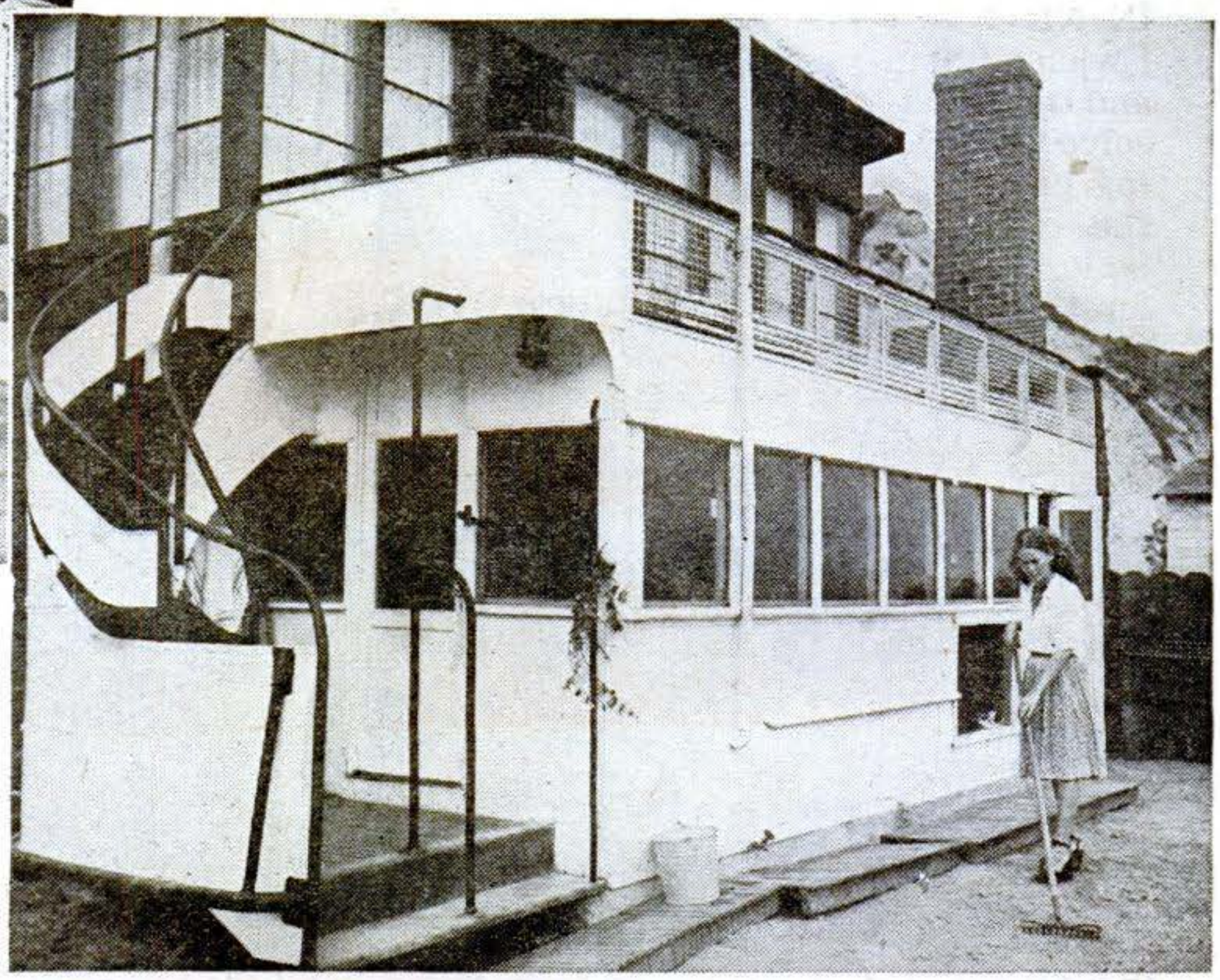
There's No Place

The top of her bus home provides Miss Burnette with an admirable sun deck. Note the chimney at what was the front of the bus. Below, a view of the cozy living room from the kitchen. These two rooms occupy all the lower-deck space.



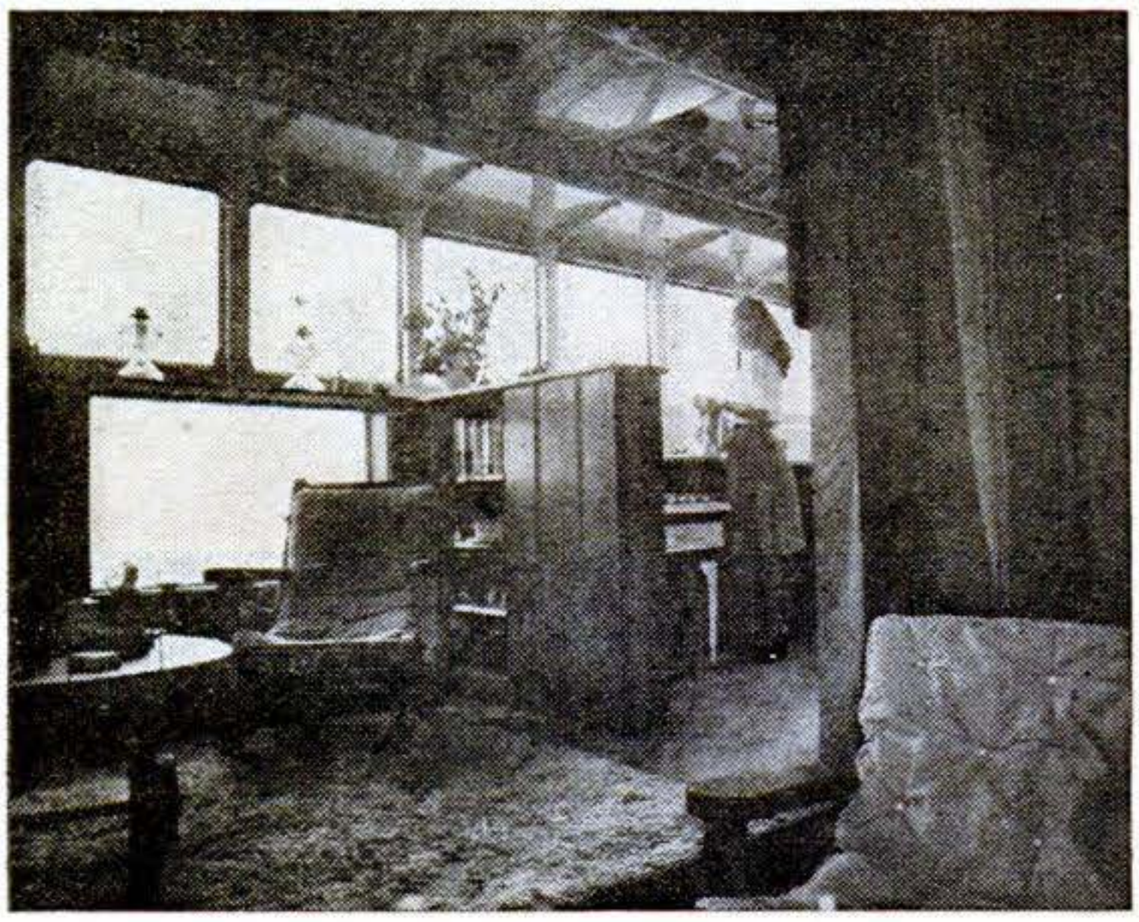
Thelma Burnette rakes the yard of her beach-site bus home. The old rear entrance is her front door. A built-on extension contains three rooms.

WITH some real ingenuity and a carpenter father, Thelma Burnette, of Santa Monica, Calif., licked the housing problem—and made money on it to boot. She bought an obsolete double-decker bus for $50. Her father, Carl M. Burnette, took the body off the chassis and set it on a concrete foundation, tore off the hood and one side, built a bedroom, dressing room, and bath adjoining the open side, and put a fireplace and chimney where the hood had been.

Then the energetic Miss Burnette sold the leather-upholstered lower-deck seats and the wooden ones from the upper deck a few at a time. She got back more than her $50.

This is the front part of the old bus with an alcove added on. The fireplace is where the hood used to be.

Another view of the living room, this time looking into the kitchen. The car cards have been left up.



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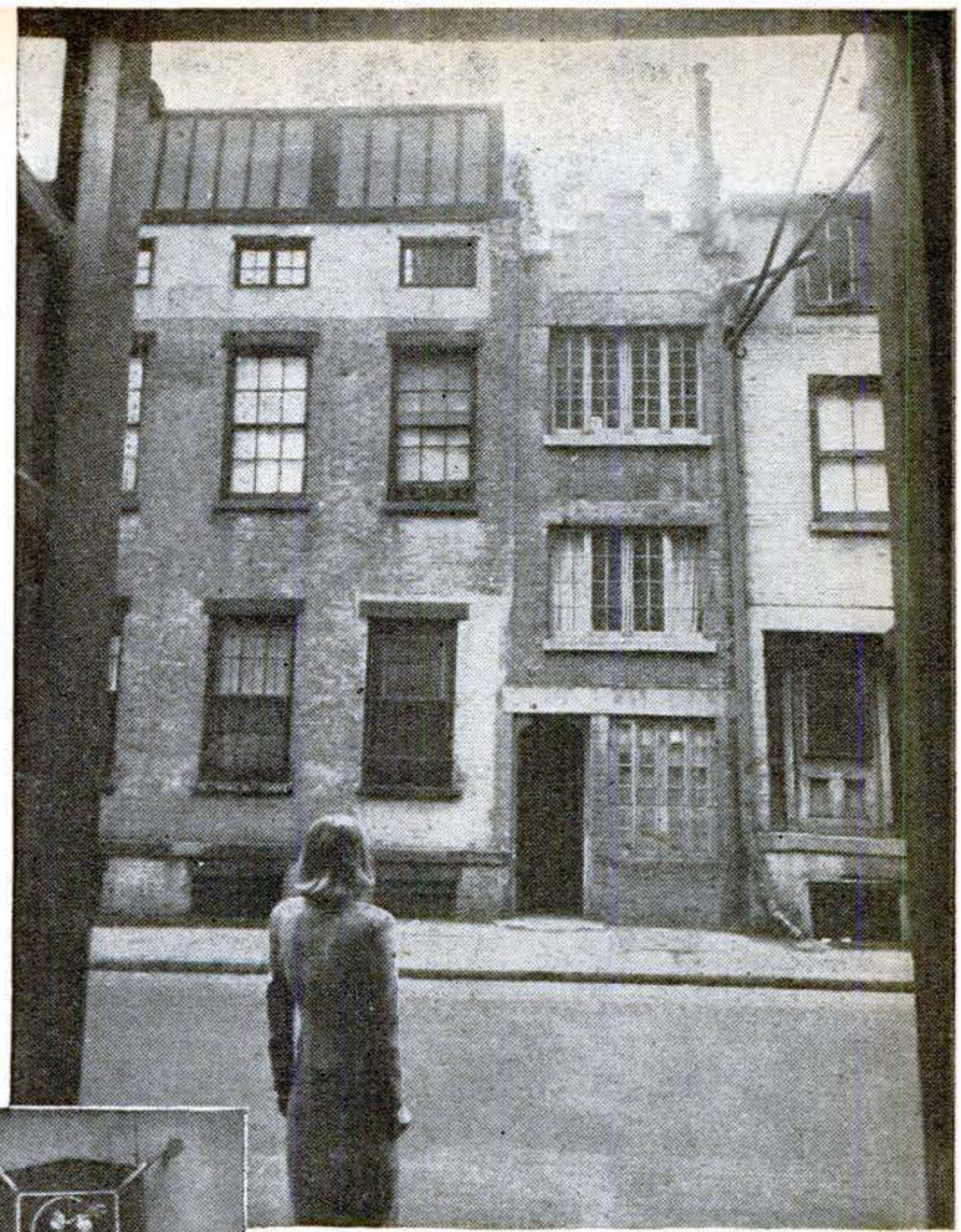
Like Home

IN NEW YORK'S crowded Greenwich Village, the Jay Barnums and their four-year-old son Timothy solve their housing problem by being broadminded enough to live in the city's narrowest house. The building is an architectural oddity built on a 9′ wide lot between an apartment house and a factory. In it the Barnums even find room for three pets—a dachshund and two cats.

The first floor contains the kitchen, a dinette, and a living room not an inch over 8½′ wide. Bedrooms are on the second floor along with a bathroom that is just big enough to turn around in. There are two bedrooms, one a "master" and the other, Timothy's, hardly bigger than a pup tent. The top floor is all one room, a long and narrow studio. It holds a piano and Barnum's drawing equipment and is used for storage, entertainment, and in a pinch as a guest room.

Guide books list the house, and sightseers often stick their heads in the window to see if anybody actually lives in such a slender structure.

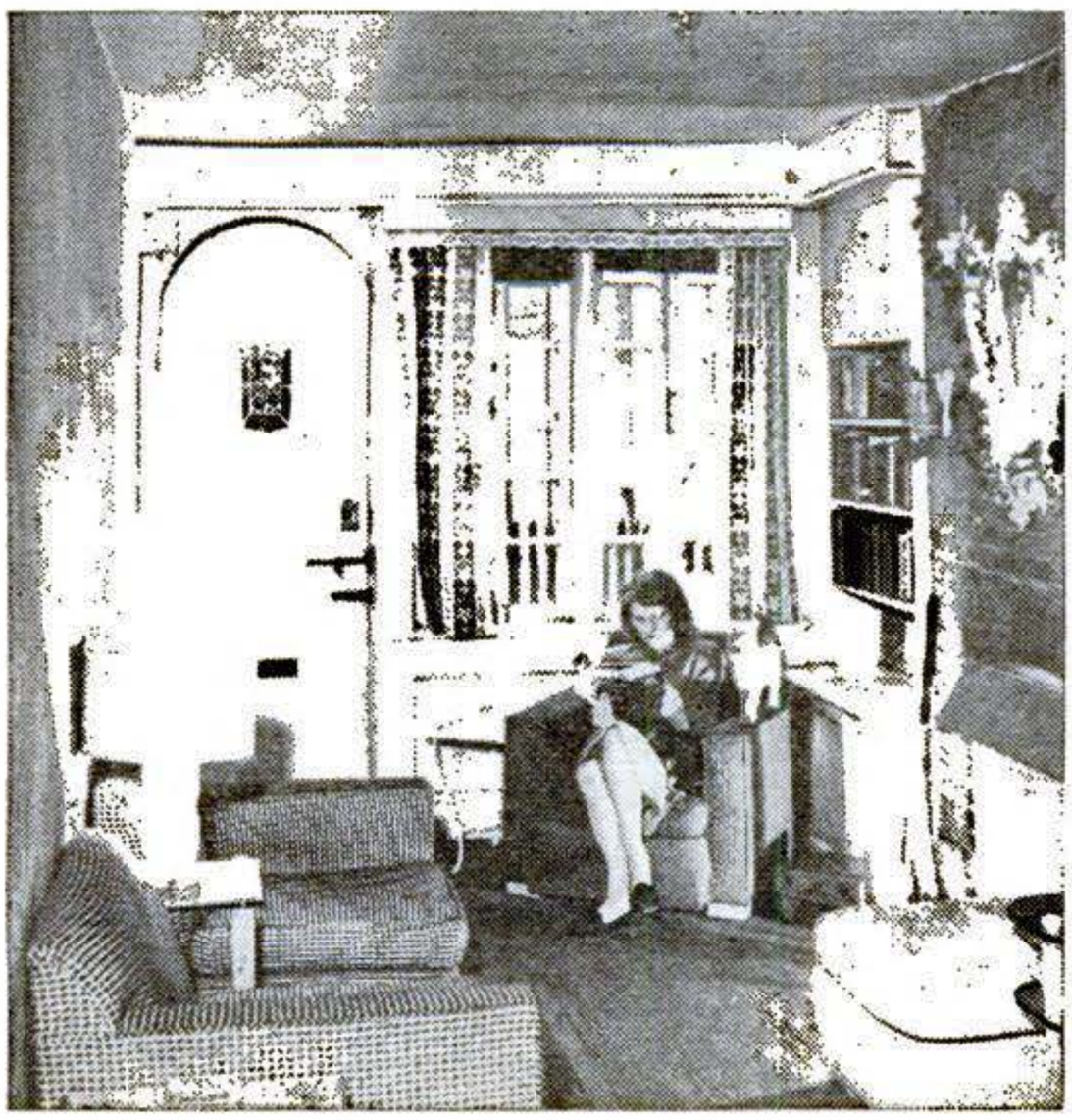


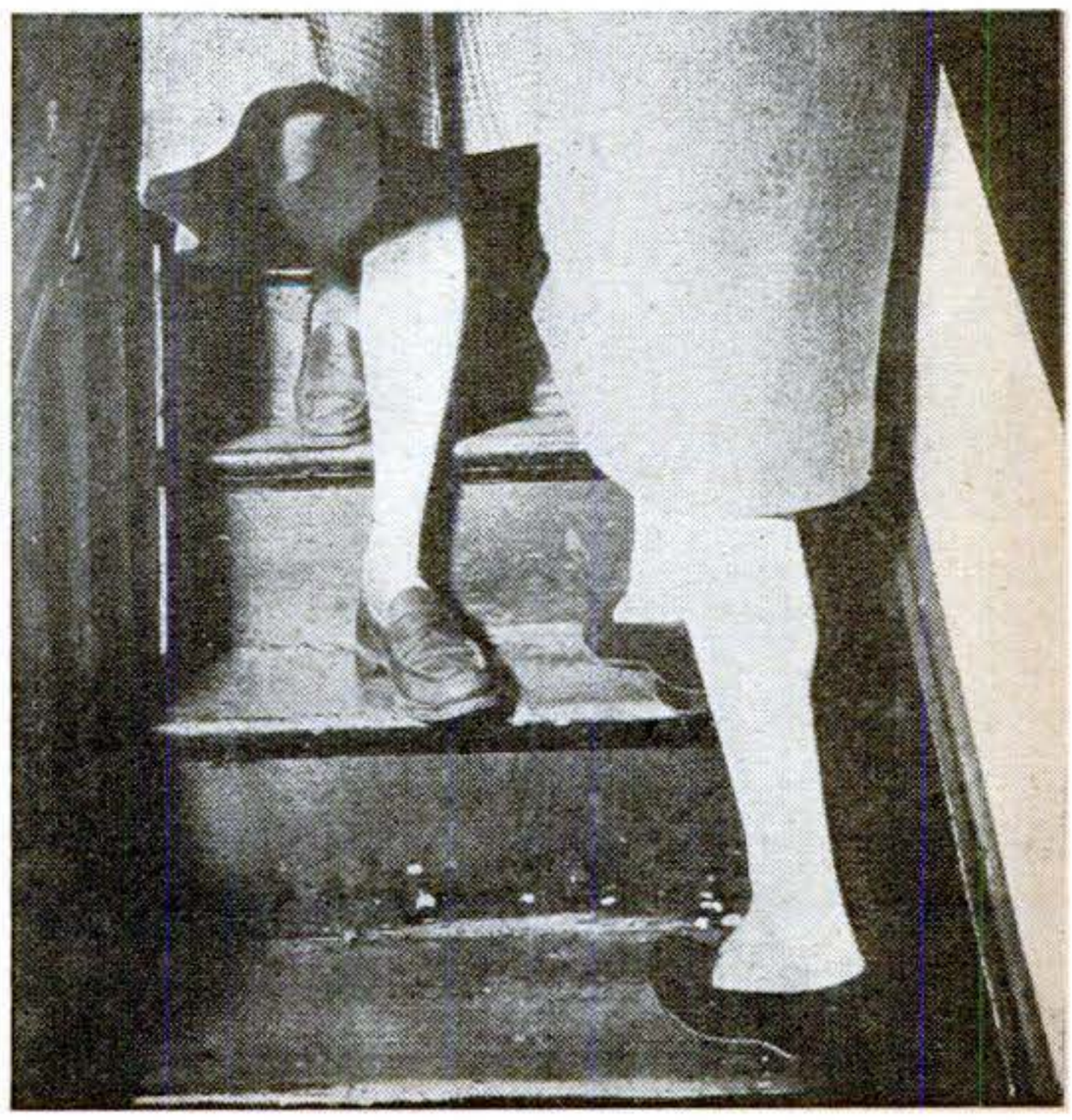
This quaint structure, on an alley-width lot between an apartment building and a factory, is New York's narrowest house.

◀ It has a number of its own—75½ Bedford Street—in the heart of Greenwich Village.

The stairway, set in the middle of the house, is only 2′ wide. As can be seen in the photo below, it's a really tight squeeze when two people attempt to pass.

Most of the furniture for this living room had to be built to order. Total width is only 8½′. The door opens on a back yard.





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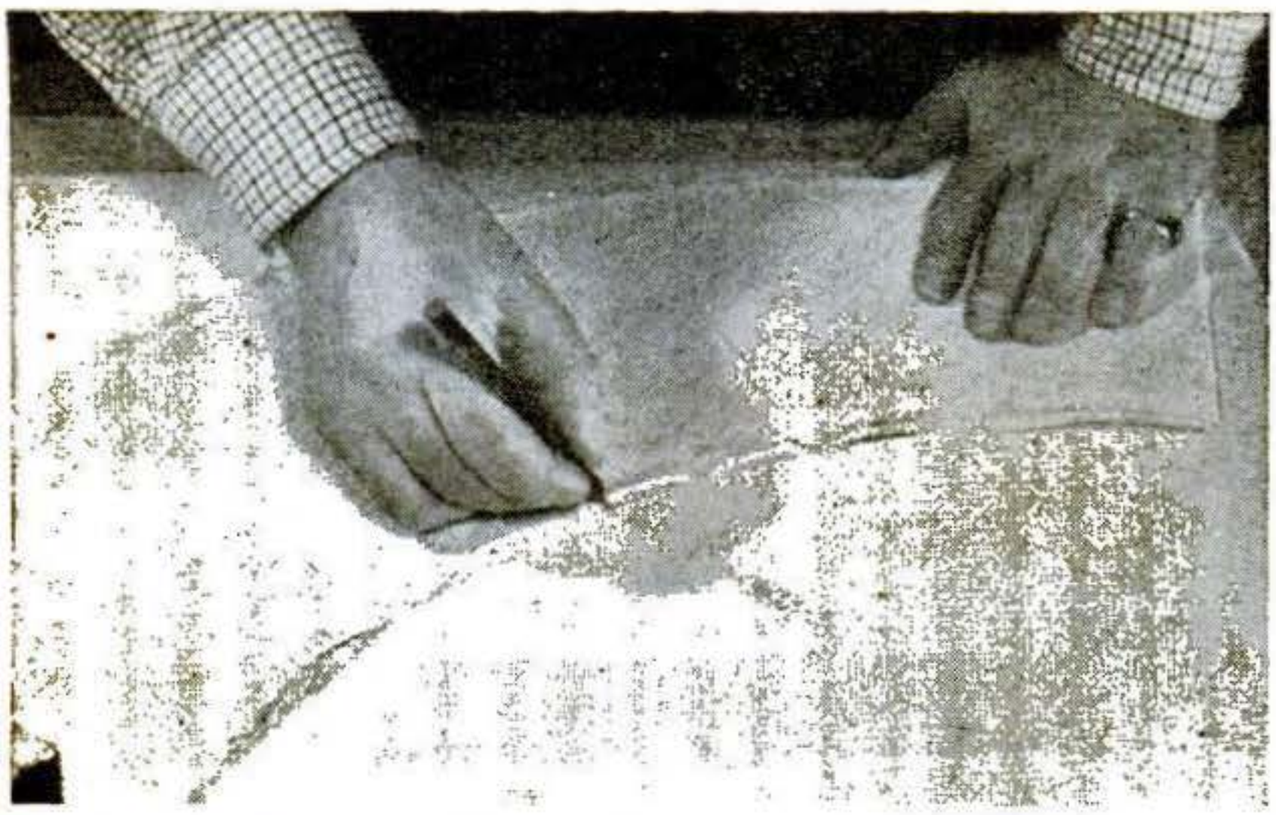
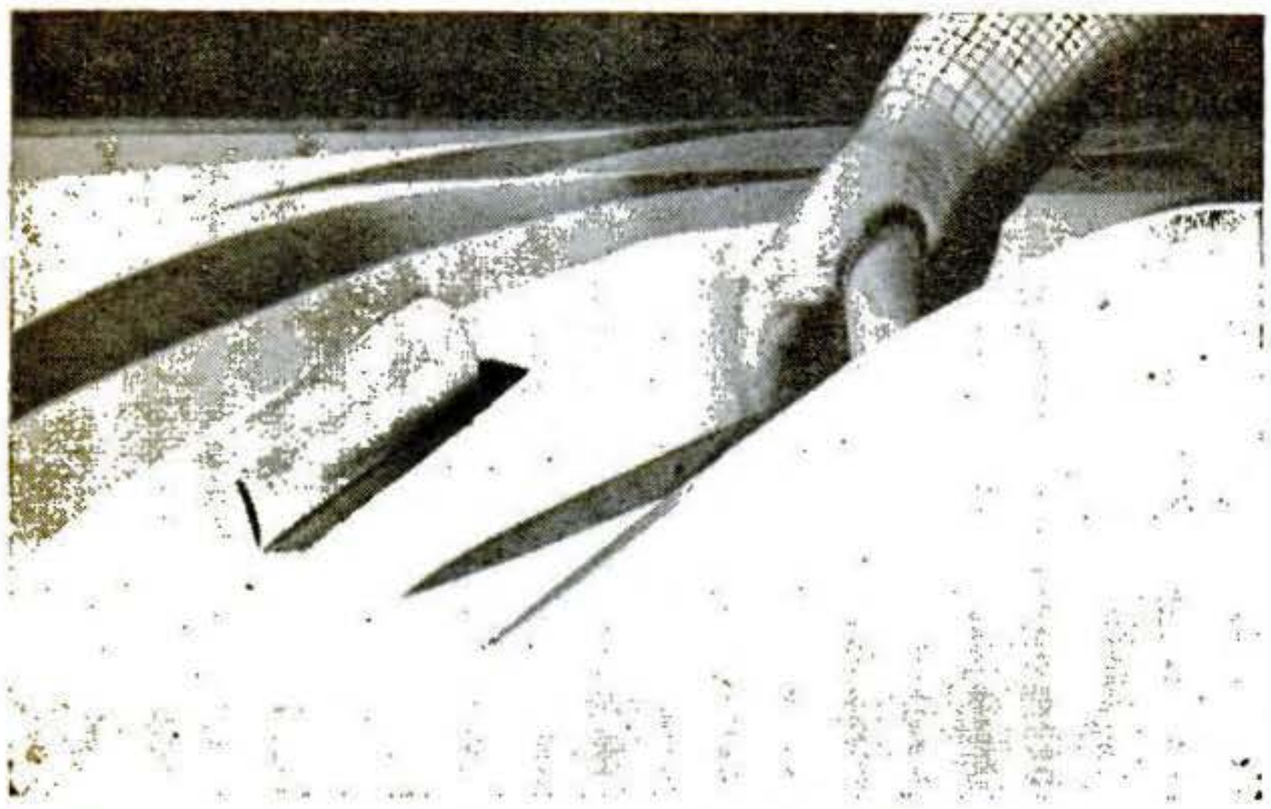
Whittling a Lamp Shade



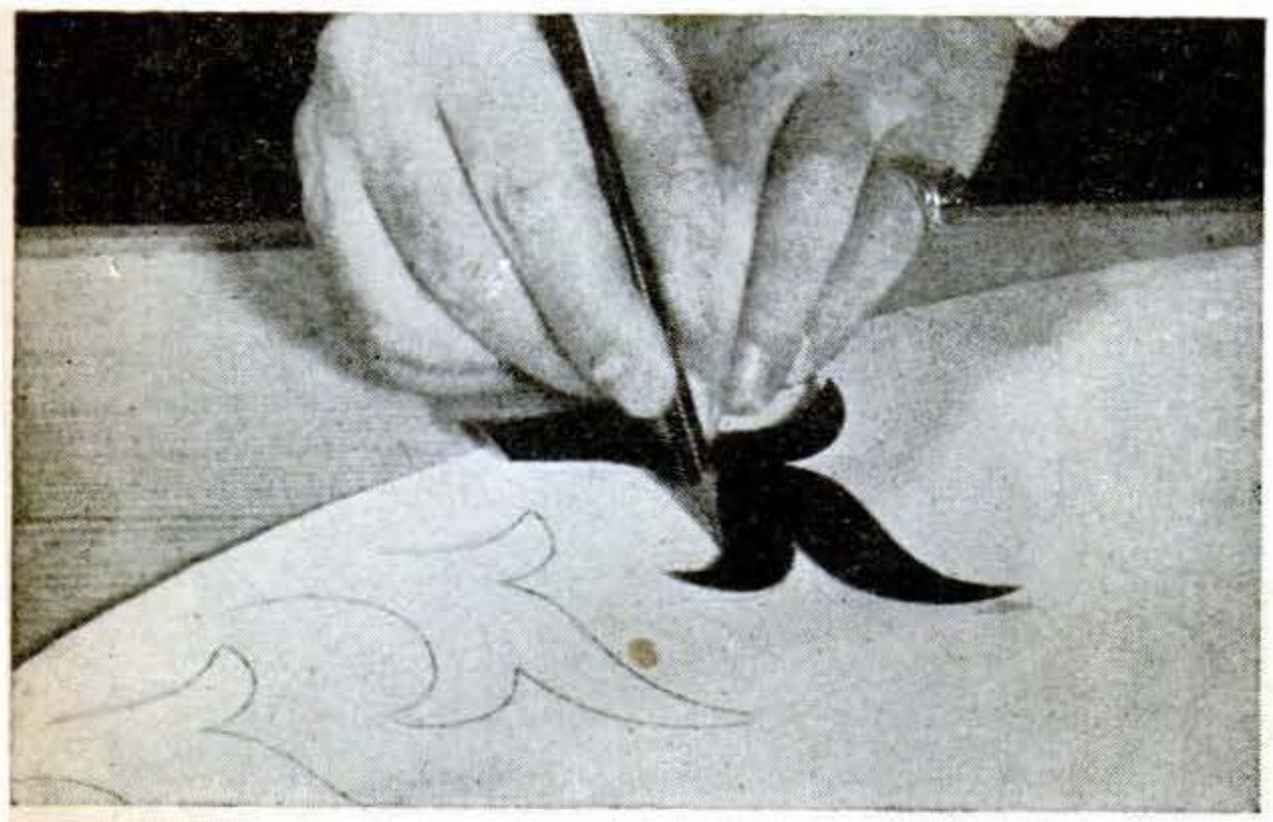
Spread out flat and laid on the top sheet of two pieces of paper, the discarded shade serves as a pattern for tracing an outline for the new shade. Weight it so it won't slip.

Following the outline, cut the two sheets of paper at one time. One will become the sculptured cover and the other a plain lining. Leave ½" extra length for a glued joint.



Only one pattern need be made for the repeated design. It can be laid out on squares, as at right, and inked in for clearness. The base touches the bottom edge of the shade.

Measure the base of the design and the length of the shade on its curved edge; then divide and mark for even spacing. Next, trace the motif at regular intervals on the border.



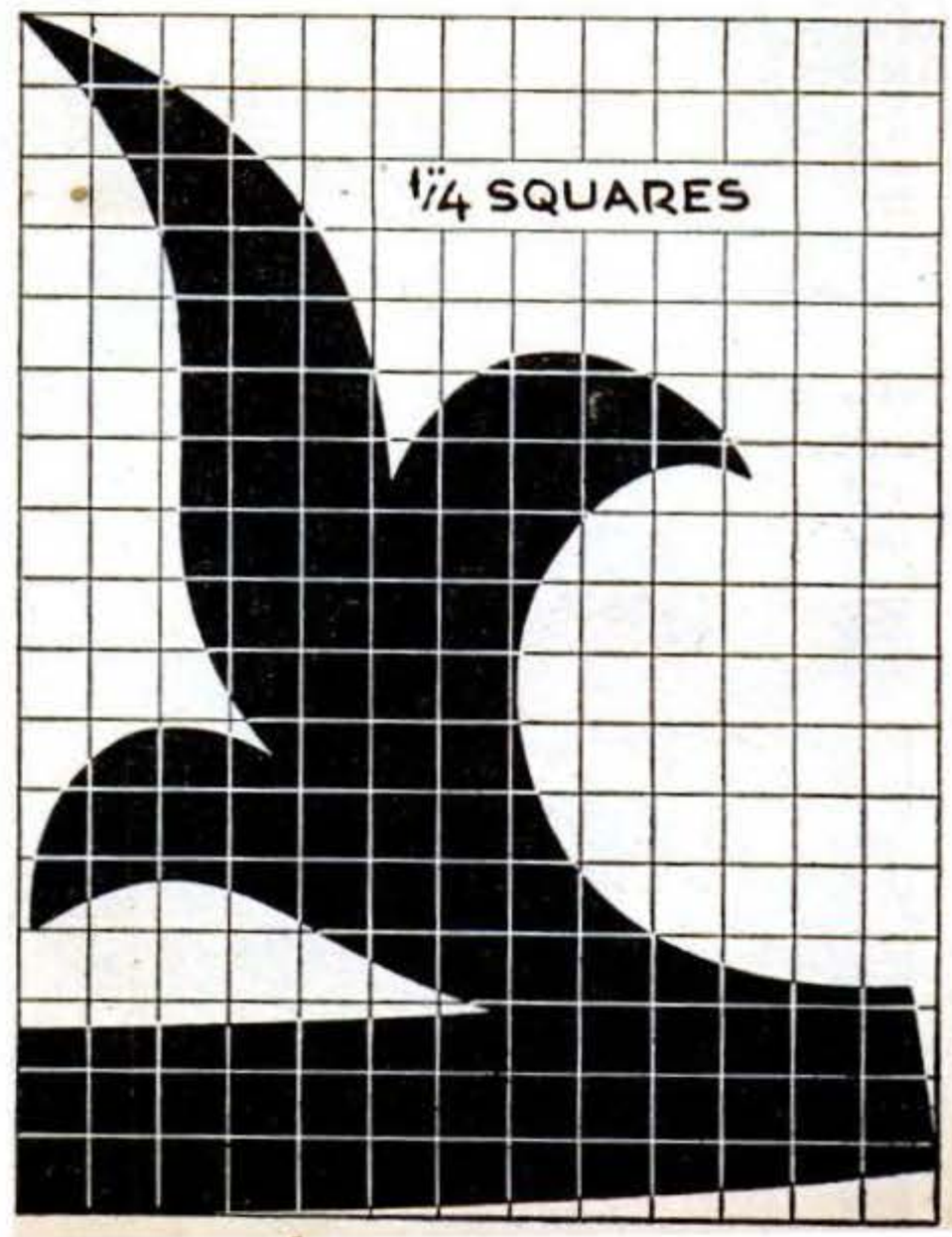
Intricate designs shaped in low relief blend with your home decorations.

By DeVERA BERNSOHN

WITH paper, a razor blade or modelmaker's knife, a little adhesive cellulose tape, and some glue, you can make a complete new set of lamp shades for your home—and at the cost of only a few cents each. By a process that need take no more than an hour or two, you can produce sculptured lamp shades that will conform to any style of home decoration. You can make massive shades for a den or library, period-blending ones for the living room, and frilly arrangements for bedrooms—all out of paper.

Jack Eisner, New York paper sculptor, has worked out a method of making unusual lamp shades trimmed with bas-relief. He uses paper and glue as others use fabric and thread, employing cutout patterns, built-up layers of paper, and other ingenious devices to achieve intricate effects.

A good Eisner example is the raised-leaf motif shown in the illustrations. The leaves are partially cut out, and the tips are inserted in slits just enough to the side to create



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from Paper

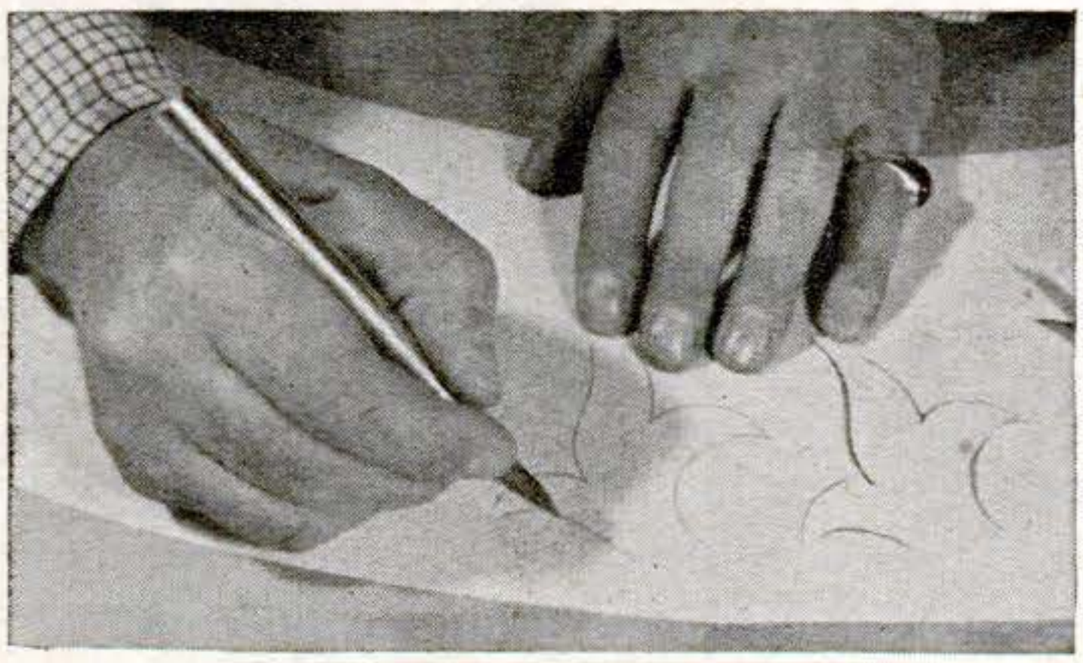
a third dimension. Light shining through causes the elevated parts to cast tapering shadows.

How it's done is shown in the accompanying photos. Remove the old shade from its frame to use as a pattern for cutting a new cover and a lining. If you have a new frame, fit newspaper around it and cut out your own pattern. Bent and broken places in an old frame can be straightened and soldered.

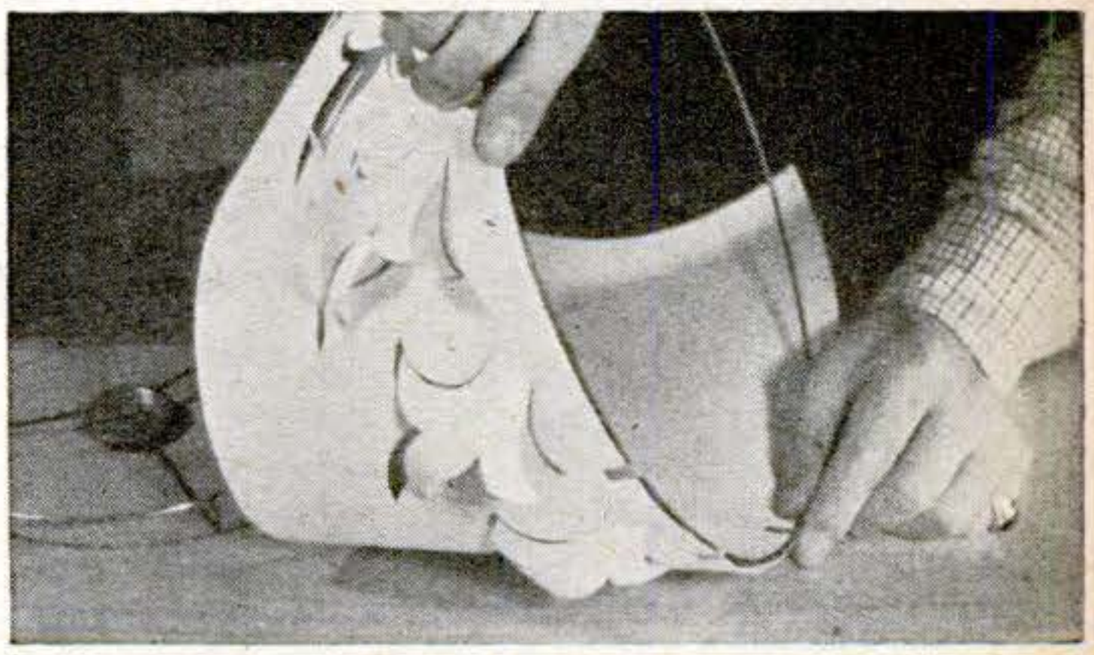
Cut both the cover and lining at one time, being sure to leave an extra ½" at the ends for trimming and making a glued joint. Space the designs carefully, using guide marks so they won't overlap at the joint.

Oyster-white drawing paper served for both the cover and lining of the shade shown, but you can use wrapping paper, thin cardboard, parchment, or any reasonably stiff paper. Or you can use a paper-and-cloth combination, with cloth glued to the cover or used alone for a lining. Cover and lining, too, may be of different colors.

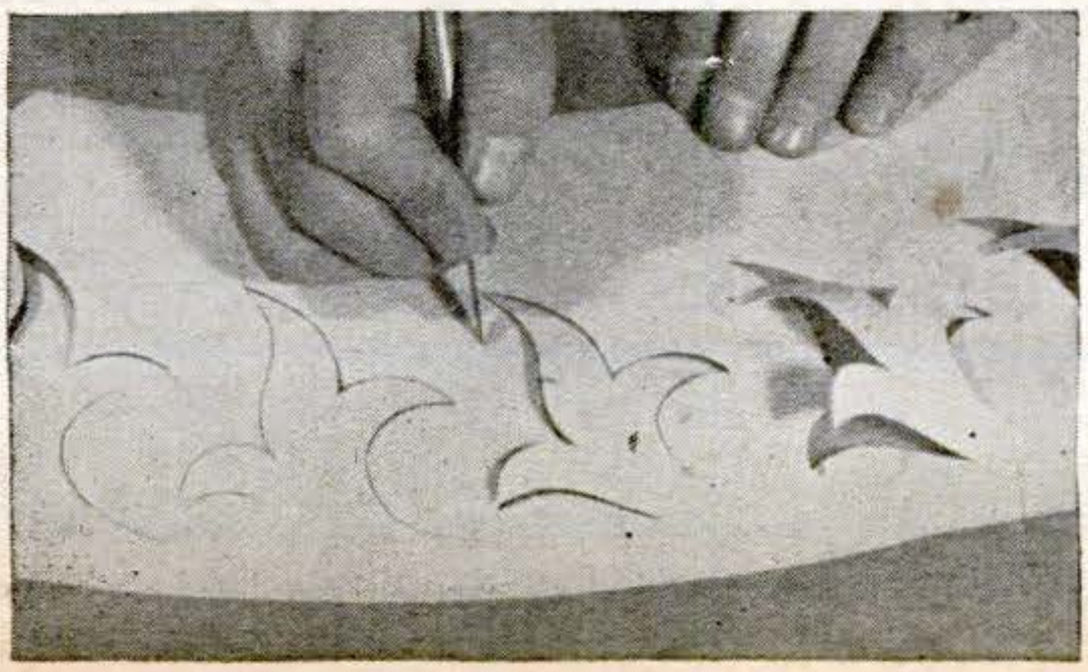
Instead of, or in addition to, the partial cutouts, other paper designs may be glued to the shade. There are numberless variations that include scoring and curls shaped around a pencil.



Use a razor blade or sharp knife to make partial cutouts down to the base of the design, as above, and cut offset slits, as below, in which to slip the leaf tips to give the motif a raised effect.



Assemble the cover and lining on the frame with strips of adhesive cellulose tape 2" apart. Glue the joint and spread a ribbon of glue inside the top and bottom. When it dries, remove the tape.



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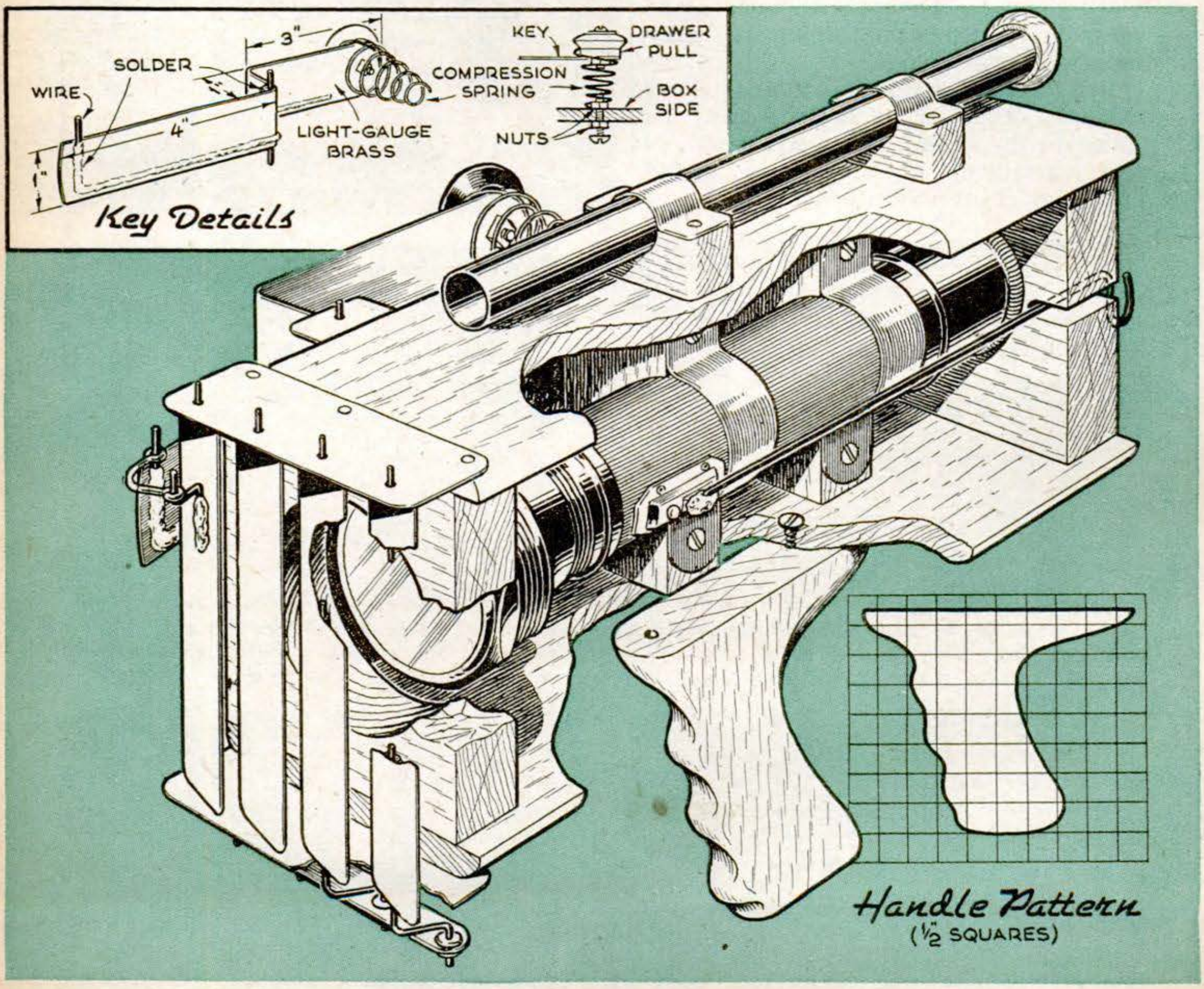
Blinker for Code

SAILORS coming home from the wars will tell you of the great services performed by signal lights in keeping convoys in communication despite strictly enforced radio silence. No less useful aboard your cabin cruiser, on camping trips, or even across the back fence, this blinker follows the Navy principle of chopping a steady beam of light into dots and dashes by means of a keyed shutter.

Because it isn't necessary to flicker the light, you need not be afraid to use a good flashlight in this rig. Any type will do so long as the switch can be manipulated from outside the box; in the one shown, a sliding switch is moved by means of a stiff wire soldered to the button.

Dimension the box itself according to the size of the light. If the lens is no larger than 2¾" in diameter, stock



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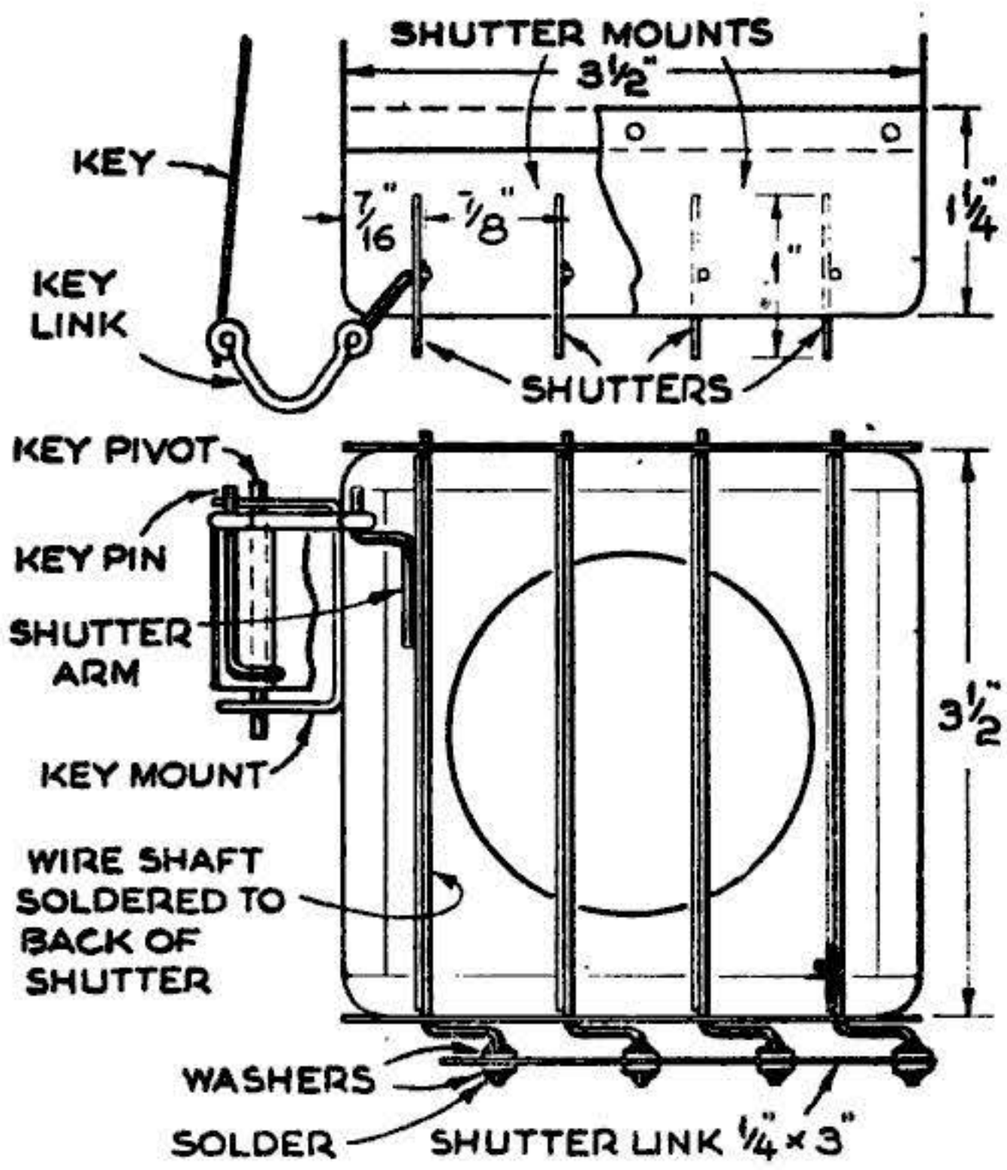
Signals

3½" square will serve for the ends. Cut three such pieces of ¾" wood, bore one to the diameter of the lens, and another to that of the barrel—probably about 1¾". Cut the second of these into two halves to form part of the flashlight holder. The rest of the holder is made of tin-can metal; shape the strips by bending them inside the wooden semicircles. Brackets for the sighting tube are made in the same way.

Details of the shutter arrangement are given in the drawing below. Shutters may also be made of tin-can metal, but a sturdier material, preferably 1/16" brass, is desirable for the key. Fasten a drawer pull to the end of the key, and insert one end of a spring under the nut. The other side of the spring is held to the box by a nut-and-bolt arrangement that can also be used to adjust the key.

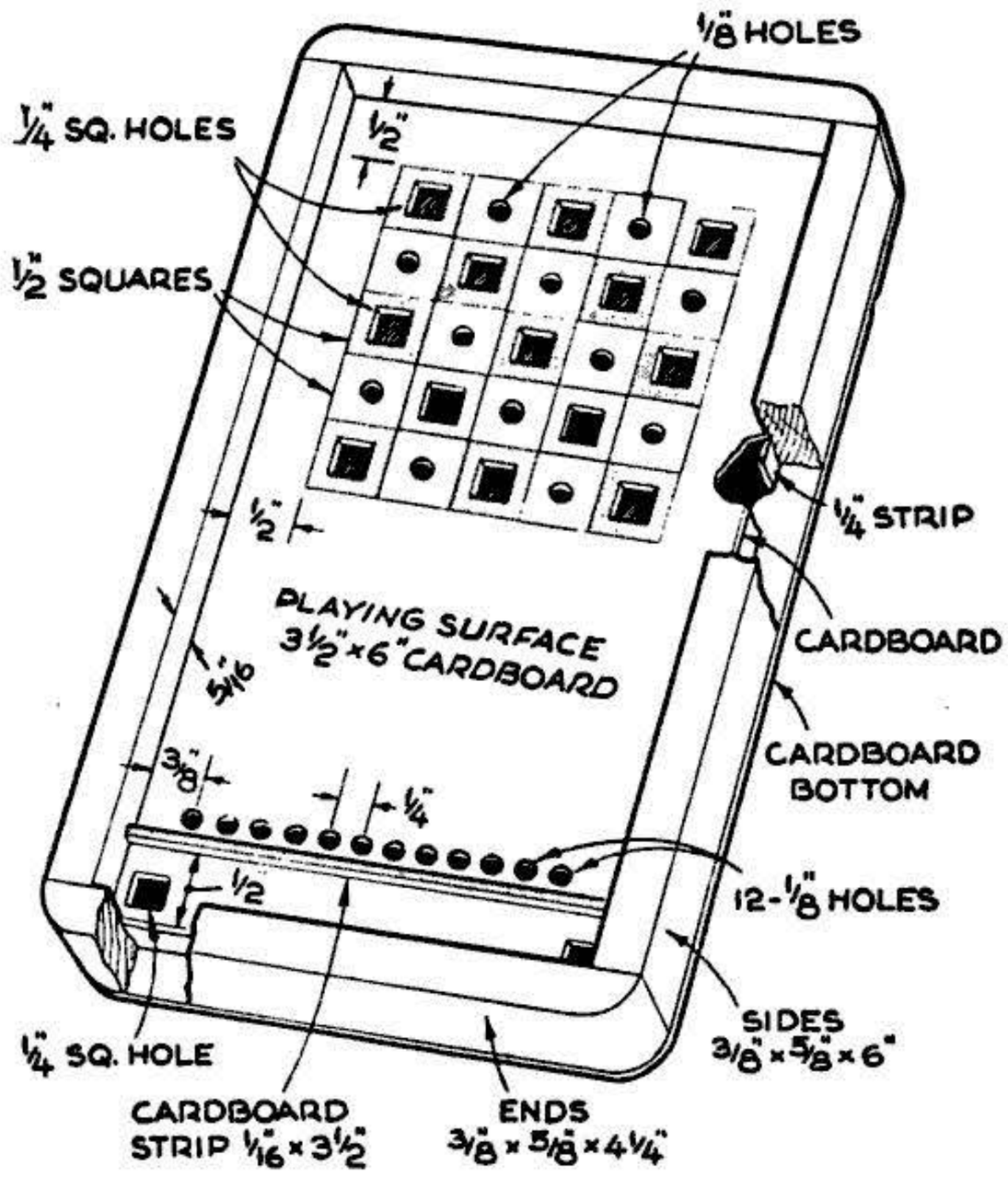
If you are left-handed, you may want to change the key position.—FREDDY MITCHELL.



Shutter Detail (SHUTTERS OPEN)

International Morse Code

A.—	H....	N—.	T—
B—...	I..	O———	U..—
C—.—.	J.———	P.——.	V...—
D—..	K—.—	Q——.—	W.——
E.	L.—..	R.—.	X—..—
F..—.	M——	S...	Y—.——
G——.			Z——..



Cardboard Game of Diagonals Is Easier to Make than Play

IF YOU think you can make 3/16" bearing balls move just as you'd like over a waxed cardboard surface, here is a game that will change your mind.

Lay out 25 half-inch squares on a 3½" by 6" piece of 14-ply showcard board. In alternate squares, cut retaining holes of ⅛" diameter with the point of a sharp knife. Twirl the tip of a pencil in the holes to smooth the edges. Cut ¼" centered openings in the remaining boxes of the checkerboard.

Twelve more ⅛" retaining holes will be needed near the bottom of the playing surface to keep the balls in starting position, and two ¼" square openings through which the "lost" pellets can be retrieved.

Glue together a wood frame and cardboard bottom, and smooth all edges with fine sandpaper. Finish with several coats of liquid floor wax.

To play the game, release the balls one at a time with the forefinger, and jockey them into the round resting-spots on the checkerboard. The object is to place the balls in diagonal lines of four; score four points for each such line, and nothing for an incomplete line. Each player goes at it for ten rounds, and high score wins. A diagonal line subsequently disarranged does not count.—FRANK SHORE.

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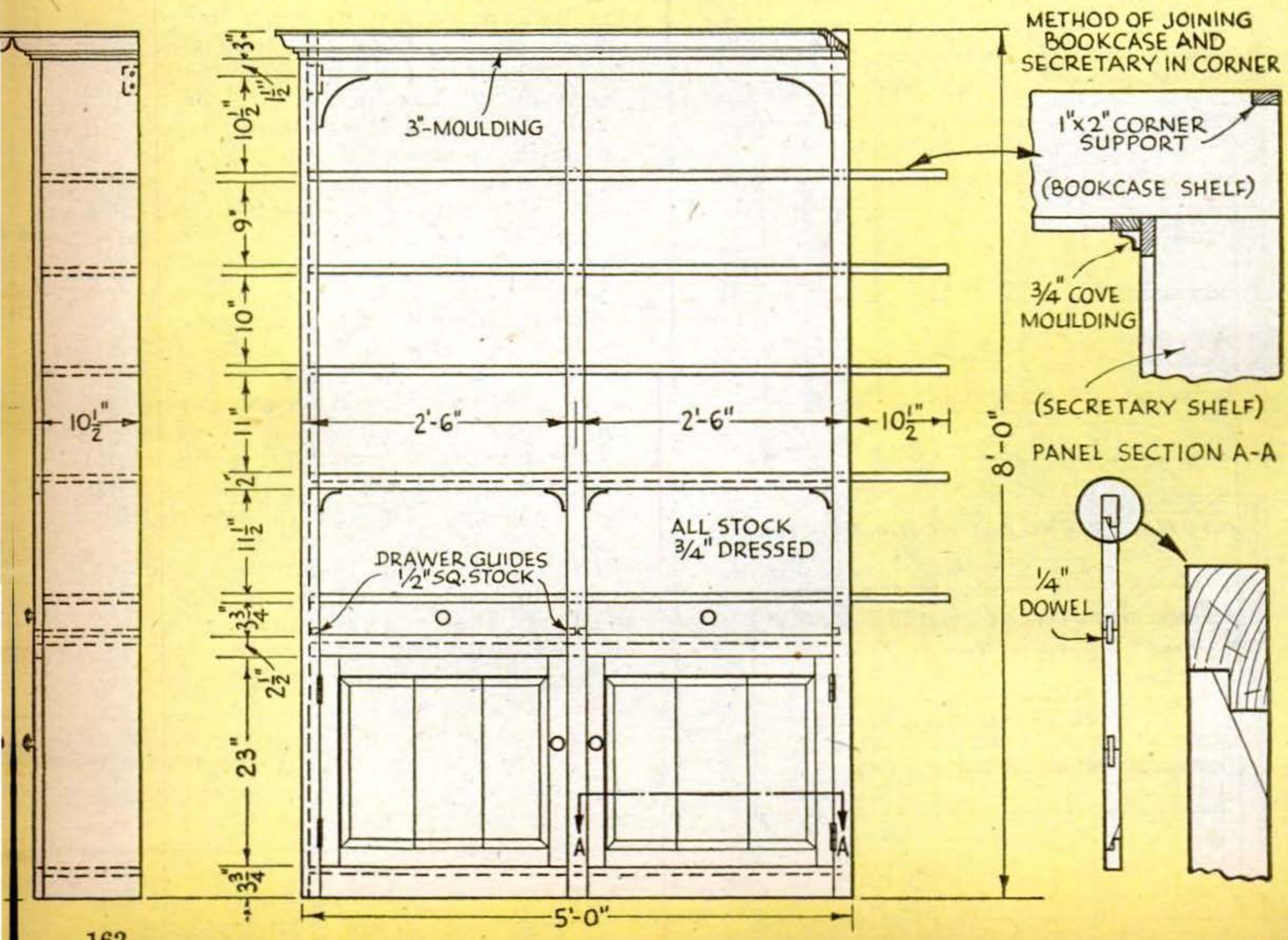

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EARLY AMERICAN KNOTTY-PINE

Bookcase and Secretary

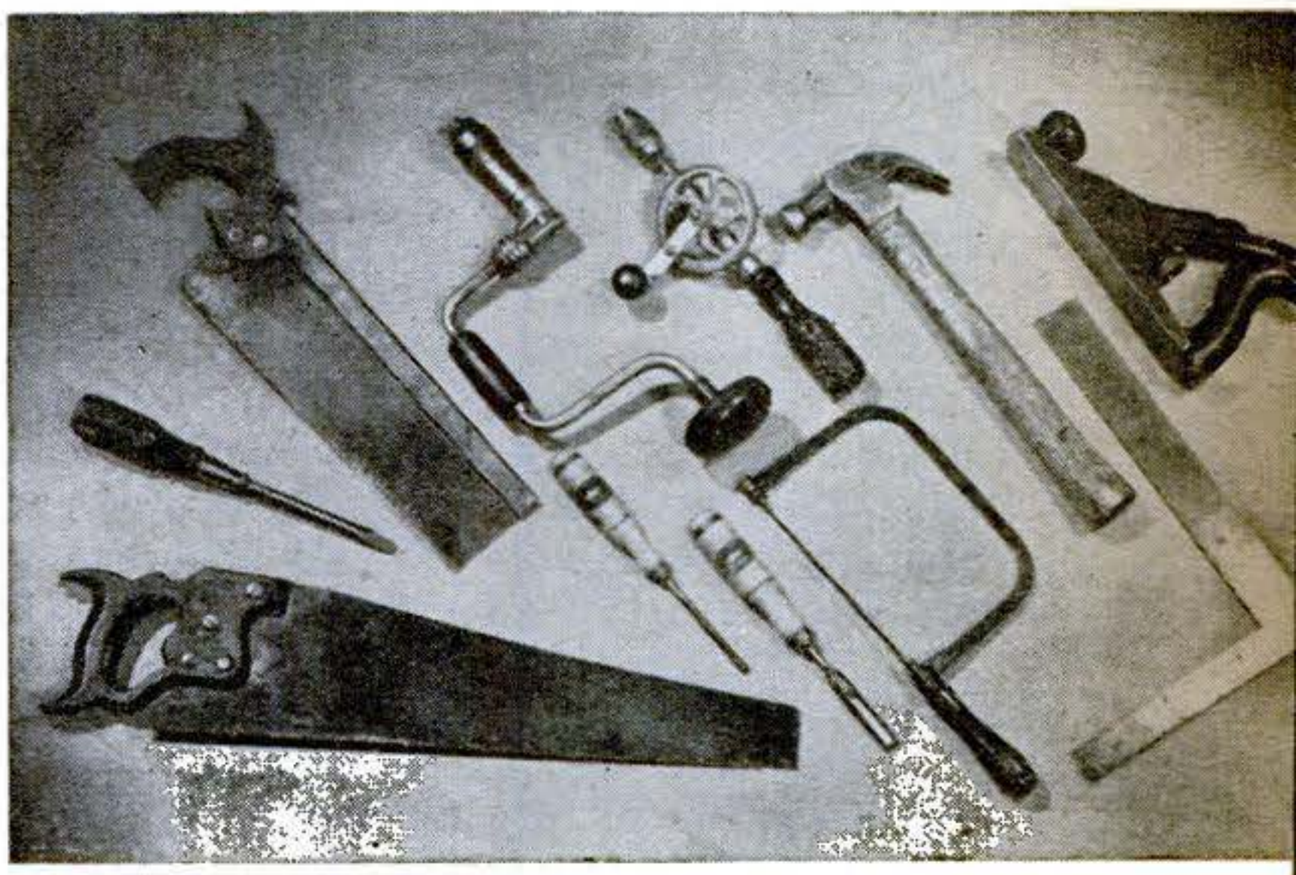
CAN BE BUILT WITHOUT POWER TOOLS

By MICHELE de SANTIS

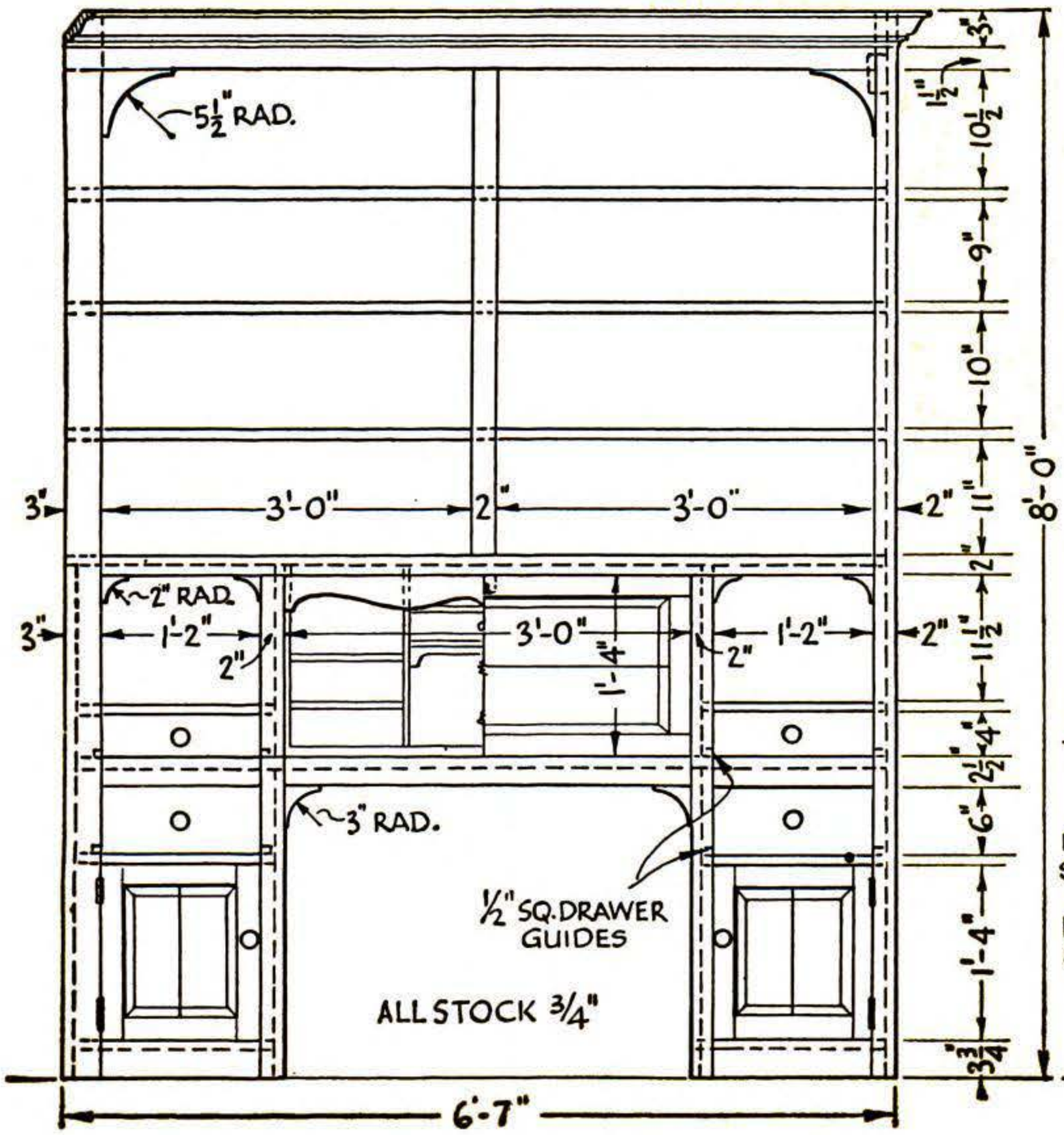
THERE is a characteristic warmth and masculine appeal to a room finished in knotty pine. The one shown here was designed as a combination study and bedroom, but it could just as well be adapted to a den or studio. The main features are the corner bookcase and secretary. Both have storage space below for albums, portfolios, and the like, while drawers provide enough room for clothes and take the place of a chest of drawers when the room is to be used as a bedroom.

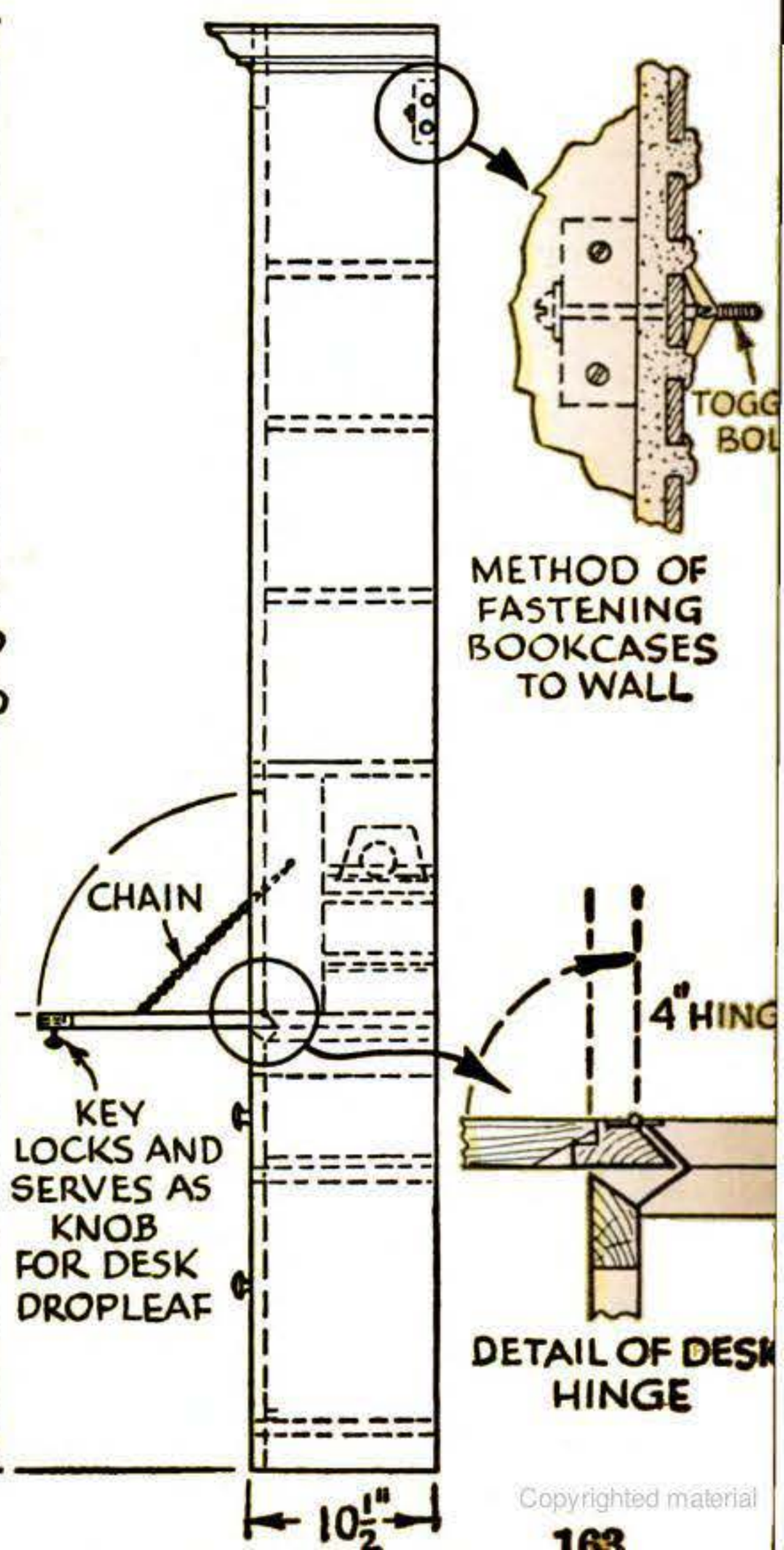
Only ordinary hand tools are required for the construction, and the wood stock, including moldings, is standard. If power tools are available, however, they will of course speed the work.

To keep the walls of the room in harmony with the built-in furniture, it is a good idea to paper them with a wallpaper simulating knotty pine in random-width boards. The cost of this is much less than that of tongue-and-groove pine boards, plywood, and similar stock, and the resulting appearance is



Such familiar hand tools as saws, plane, square, chisels, brace and bit, hammer, and screwdriver are all that are required to build the bookcase and secretary shown on the facing page. Details of construction are given in the drawings below.





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as pleasing in many respects. An addition to the cozy atmosphere is a ceiling of fiber insulation tiles.

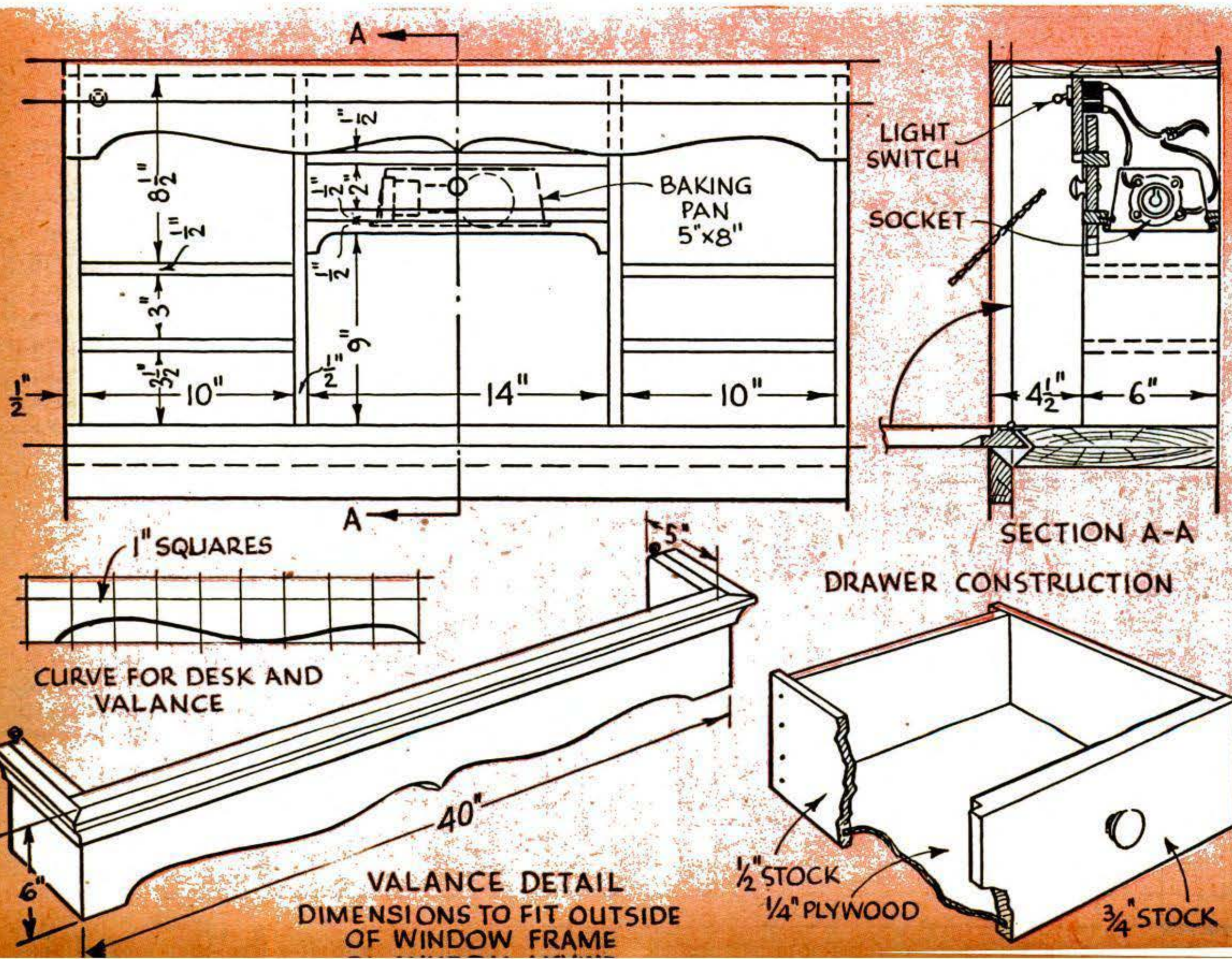
Detail drawings are given of all parts of the bookcase and secretary. The dimensions, of course, will have to be changed to suit the height of the room in which the pieces are to be built and also the width of the wall space to be filled. If the width of the wall on which the bookcase is to go is much more than 5′, it may be a good idea to design the piece to be divided by two uprights instead of one and to have three doors to the cupboards instead of two. More than one upright can also be used for the shelves above the secretary desk if desired.

The heights of the shelves are also, of course, subject to change to suit the height of the books, models, or other objects that are to be accommodated and also to fill the wall height pleasingly. Proportions given in the drawings will be found, however, to be harmonious, and they should be followed as closely as possible. Note that the lowest shelf has the greatest height and the one next to the top has the least. This provides a sense of balance and permits the display of the heavier articles on the lower shelves. The top shelf is a full 3½″ greater in height than the lowest. This is in keeping with good design, and part of this height is effectively taken off by the 3″ molding and its 1½″ base.

A feature of the desk is the concealed electric light. This light, as one of the detail drawings shows, is made from a baking tin of the type used for making bread or cooking meat loaf. The socket, an ordinary porcelain one, is bolted to one end. Besides being concealed, the lamp has the additional advantages of giving a soft, indirect light and of saving desk space. The concealed lamp, controlled by a toggle switch, is recessed behind a stationary panel that has the appearance of being a small drawer. If you wish, you could substitute a rotary on-off radio switch with a wooden knob that will look like a drawer pull.

The corner construction of the bookcase and secretary gives them added strength and helps to hold them in place, as does the fact that they are built to the full height of the room. But for additional security, two small blocks are fastened to the upper part of the wall near the outside ends by means of toggle bolts, as shown in one of the details, and the ends of the cases are anchored to them with screws.

All the shelves of the bookcase extend from the outside end to the opposite wall, and the shelves of the secretary abut them, making it unnecessary to provide a partition behind the corner post. The shelves themselves are held in front by nails through the uprights and in the rear by vertical cleats cut to the space between shelves.



Wooden valances over the windows blend with the secretary. A bulletin board holds world maps.

Cupboard doors are simple board panels fitted together with dowels, as shown in one drawing, and then framed. An attempt should be made to have the panel stock of such width that the joints will divide the panel evenly inside the frame.

The writing surface of the secretary desk is also built as a framed panel and is a drop leaf that completely closes the writing compartment when raised. It is supported when lowered by chains that hold it level. If a desk pad is used on top of this, it will not be necessary to fill the seams in the wood for an even writing surface.

Care should be taken in fitting the drawers so they pull out easily. Butt joints, as shown in one of the drawings, are satisfactory at the back, but the fronts should be rabbeted to receive the sides.

Wooden knobs for the drawers and doors can be purchased unfinished at small cost. No knob is required for the writing drop leaf since it can be pulled out by the key in its lock. The cupboard panels are held closed by spring clips.

Before finishing, fill all cracks and countersunk nailheads with wood filler. It is advisable to use a filler that will take an oil stain uniformly. Next, do a thorough sanding job on all parts, and then with a cloth apply an oil stain to match the wallpaper or wood on the wall, or better still, make the bookcase and secretary a shade or two darker than the walls. Apply the stain lightly or diluted and repeat with additional coats until the desired tone is obtained. Do not make the mistake of applying too dark a stain as the initial coat because it impregnates the wood and cannot be rubbed off readily. After the stain has dried, finish with several coats of good-quality hard furniture wax. Another good finish would be to use semigloss varnish, followed by wax.

Two additional features of the room are independent of the bookcase and secretary but add to the attractiveness of the project. They are wooden valances to match the scroll over the desk, and a bulletin board. This board should be large enough, approximately 4′ by 5′, to hold world maps, travel posters, bulletins, school notices, and the like. It is made of a sheet of composition-board paneling of a texture that will take thumbtacks and is framed with a simple natural-wood molding. The use of colorful travel maps not only provides a decorative feature for the room, but it also supplies an atmosphere of adventure and romance.

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RUSTIC LAMP

Kerosene Barn Lantern Converted to Electricity for Ceiling Light

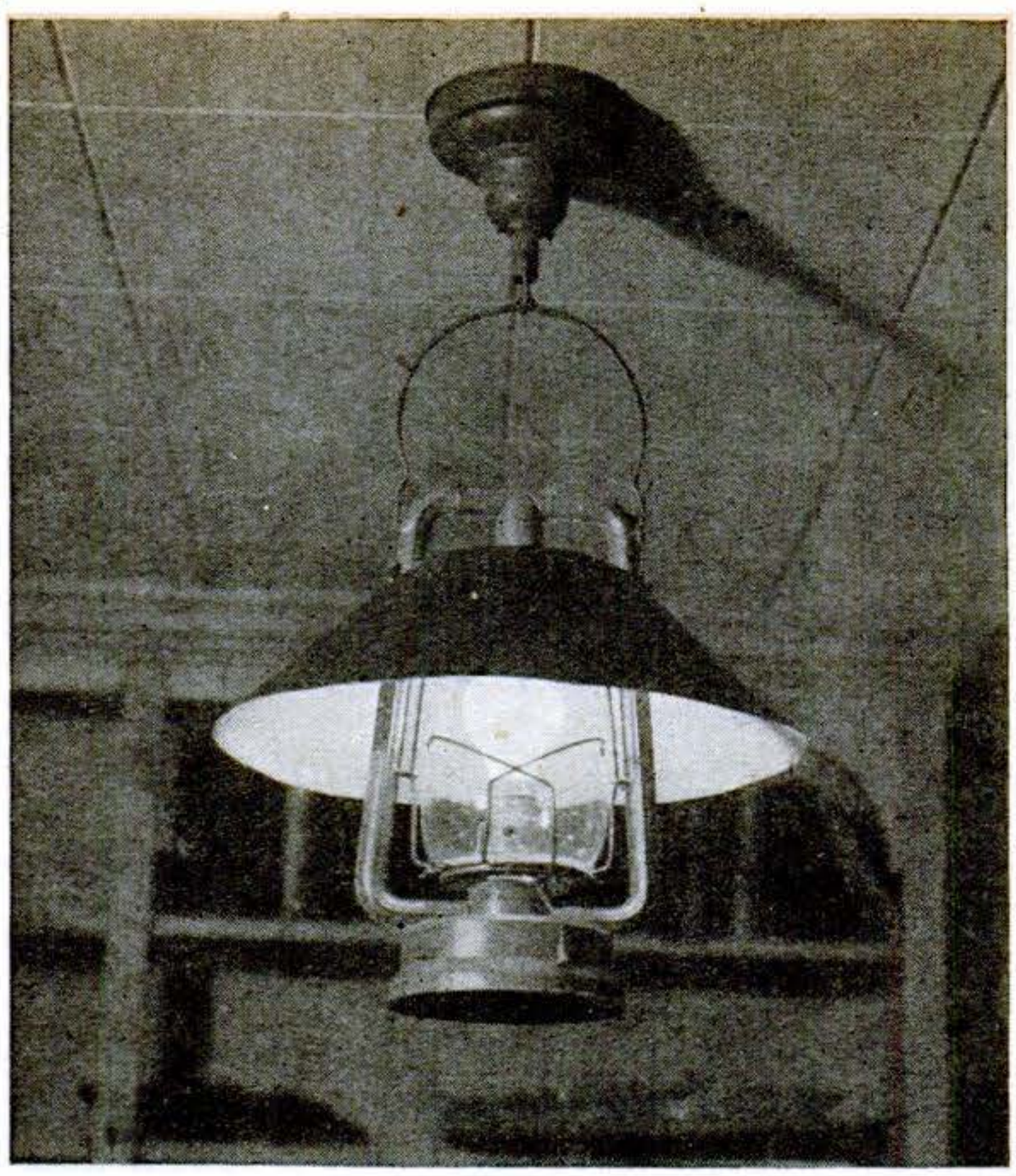
HERE is a rustic lamp that can be made from an inexpensive kerosene barn lantern. It will fit in an early American room or a rustic cabin or on a porch living room, or several such lanterns can be grouped and suspended from an old wagon wheel for greater illumination in a meeting room, barn theater, canteen, or the like.

To electrify the lantern, remove the wick unit, and then drill a hole in each side of the tubular frame just above the juncture with the handle. Separate the two wires in an electric cord and run them through the tubular frame, as indicated in the drawing, pulling the ends through the opening left by removal of the wick unit. The upper ends of the wire are then bound to the handle with sufficient length above to permit connection in the ceiling fixture.

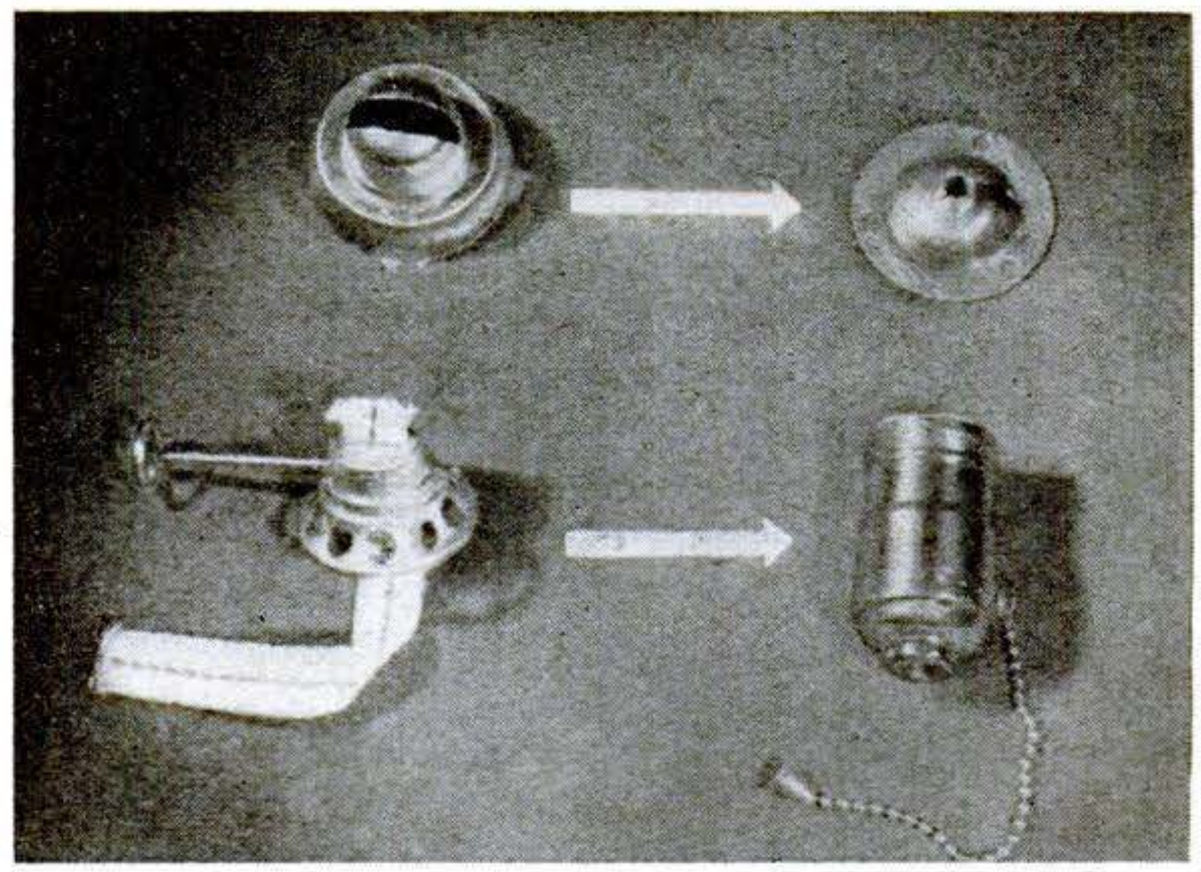
Replace the wick unit with a nipple and flange soldered to the frame or with a fitting made of a plywood or fiber disk and a ⅛" pipe nipple. Screw a socket shell on the nipple and connect the wires.

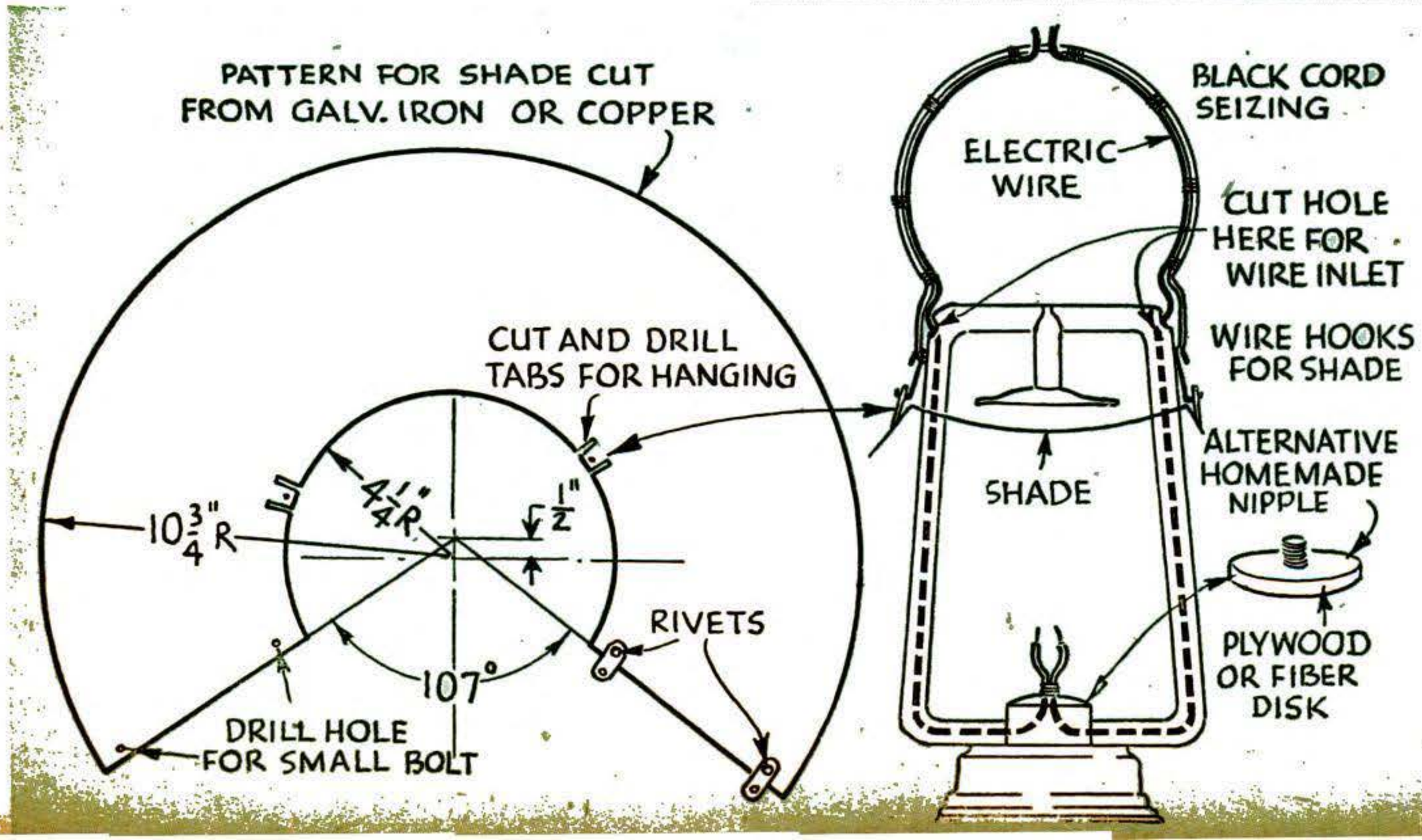
The shade is light sheet metal cut from a pattern as shown in the drawing. Two drilled tabs support it on C-hooks hung over the lantern handle. In laying out the tabs be sure to allow for extra weight on the joint side of the shade so it will hang evenly balanced. Do not bolt the ends of the shade together until it has been hung on the lantern, or it may not go over the handle.

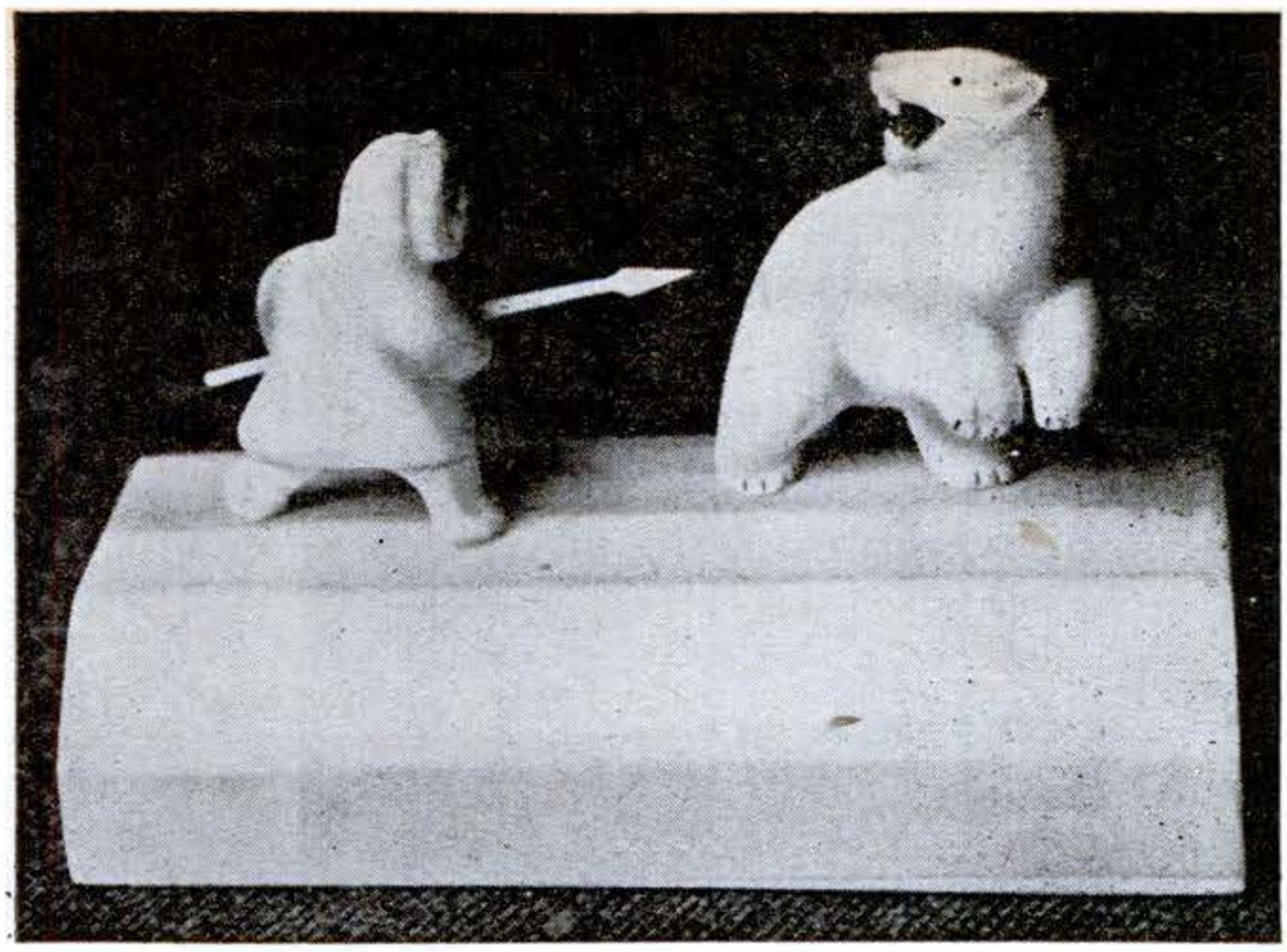
Paint the lamp reddish brown to resemble copper. The shade may be dark green outside and white inside.—M. DE S.



Removal of the two wick units permits installation of a nipple and socket in this ceiling-hung lamp.





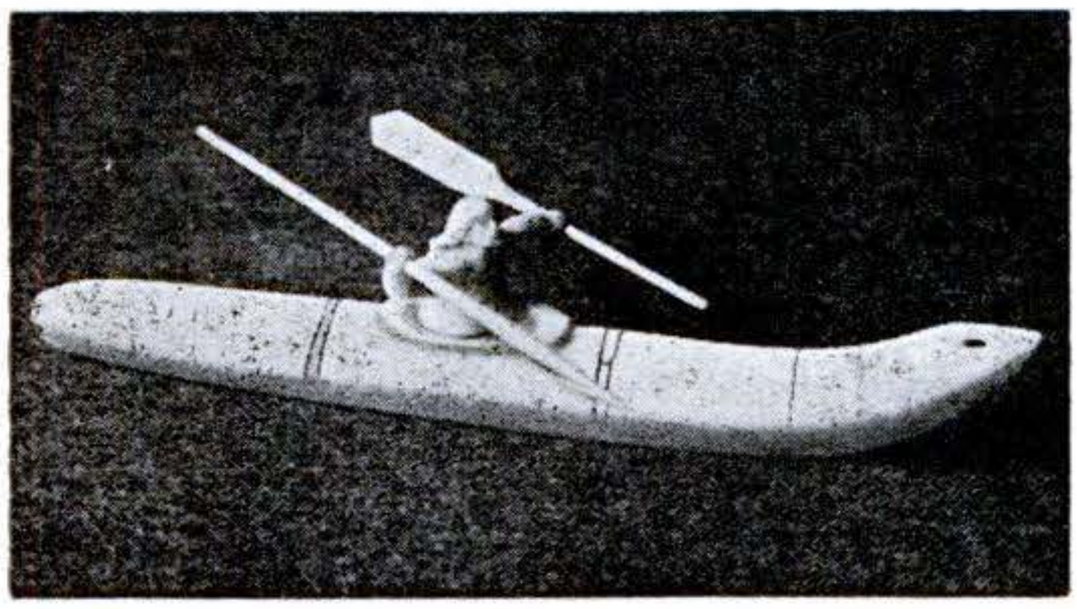


Armed with a spear, an Eskimo battles a bear on a paperweight.

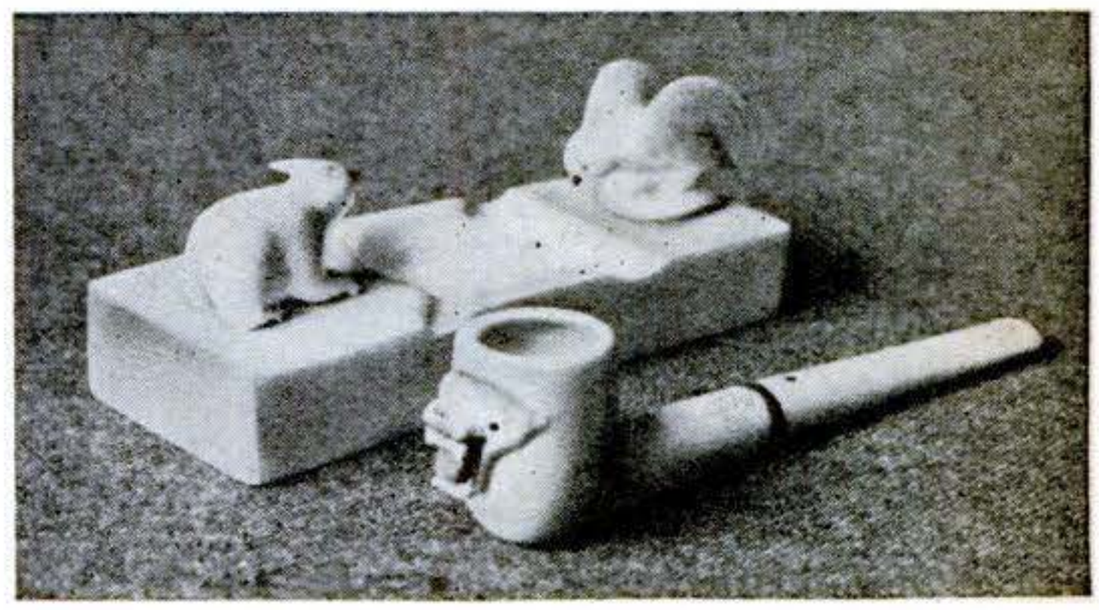
Eskimos Carve Figures from Walrus Ivory

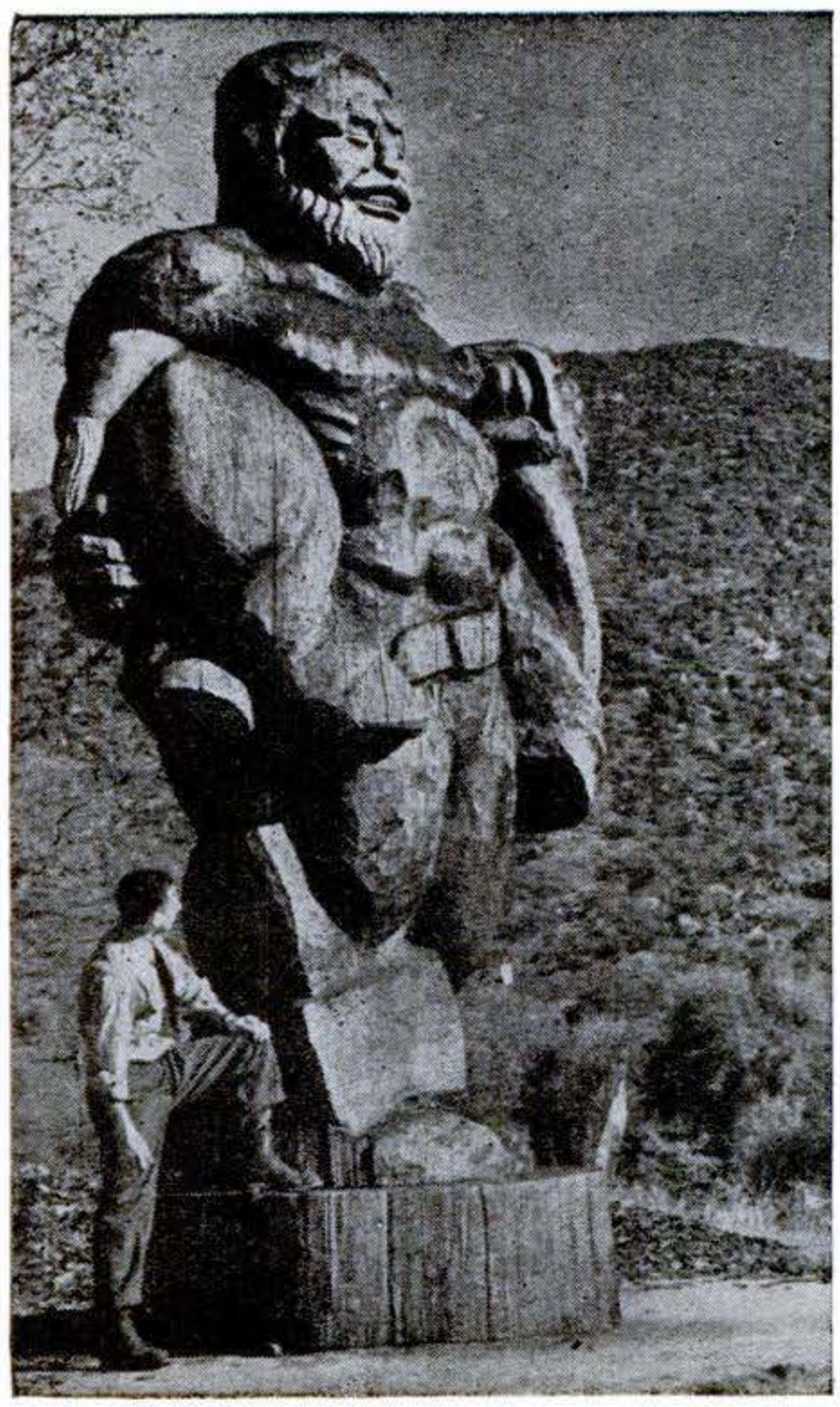
TYPICALLY native in subject and execution, and therefore unique among craft products, are statuettes and trinkets carved by Alaskan Eskimos from the tusks of the Bering Sea walrus. Examples of the work are shown in the accompanying photos. Handicrafts such as this are being encouraged by the U. S. Department of the Interior, which helps to distribute the product. Native sculpture, once held in disregard by Eskimos, has now become a means by which they add to their income.

His native kayak as the Eskimo sees it in ivory.



Pipe and ash tray carved from tusks of walruses.



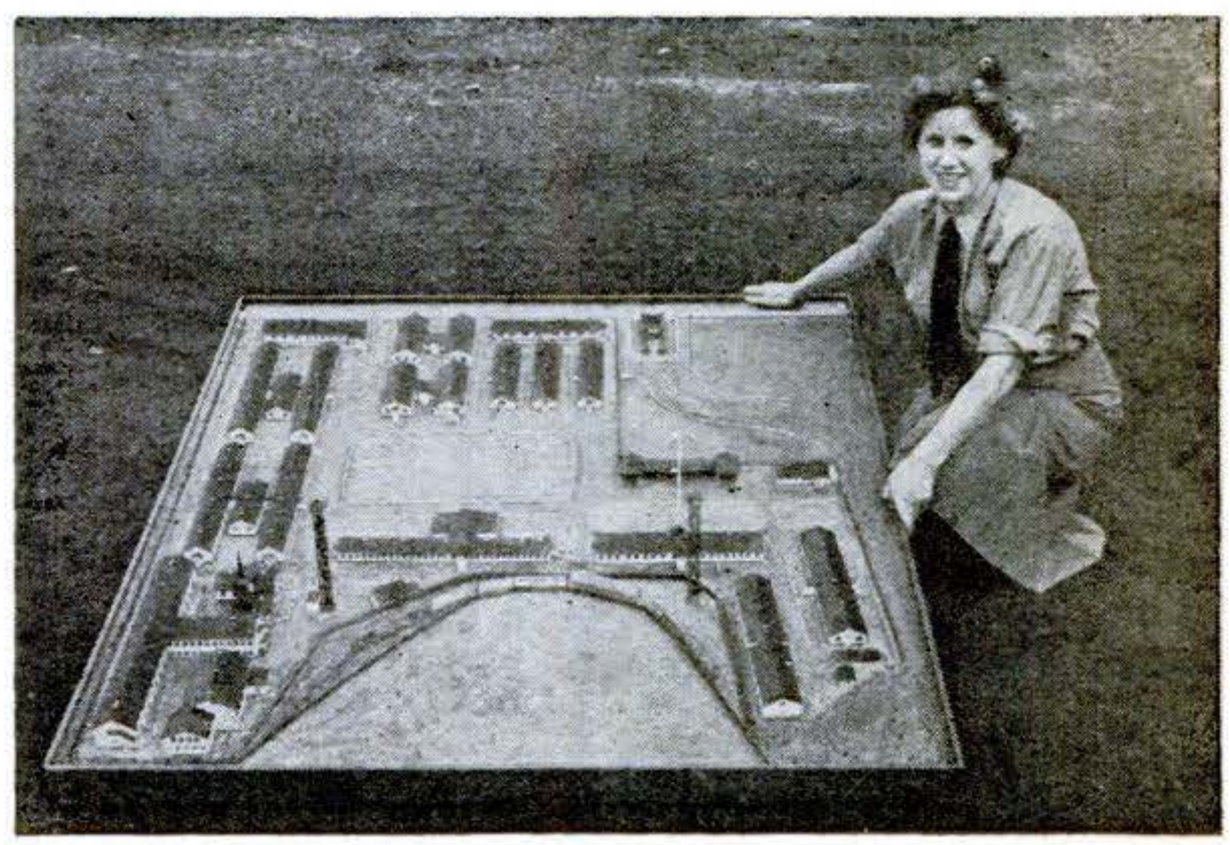


Giant Statue Chiseled from Wood

FROM a single block of wood of the giant sequoia, this huge likeness of the legendary Paul Bunyan was carved by Carrol Barnes, of Three Rivers, Calif. It stands over 25′ high.

War Memento Modeled by Women

AS A souvenir of the first training camp in Canada for the Royal Norwegian Air Force, members of the women's division made this model. The camp, "Little Norway," was near Toronto.



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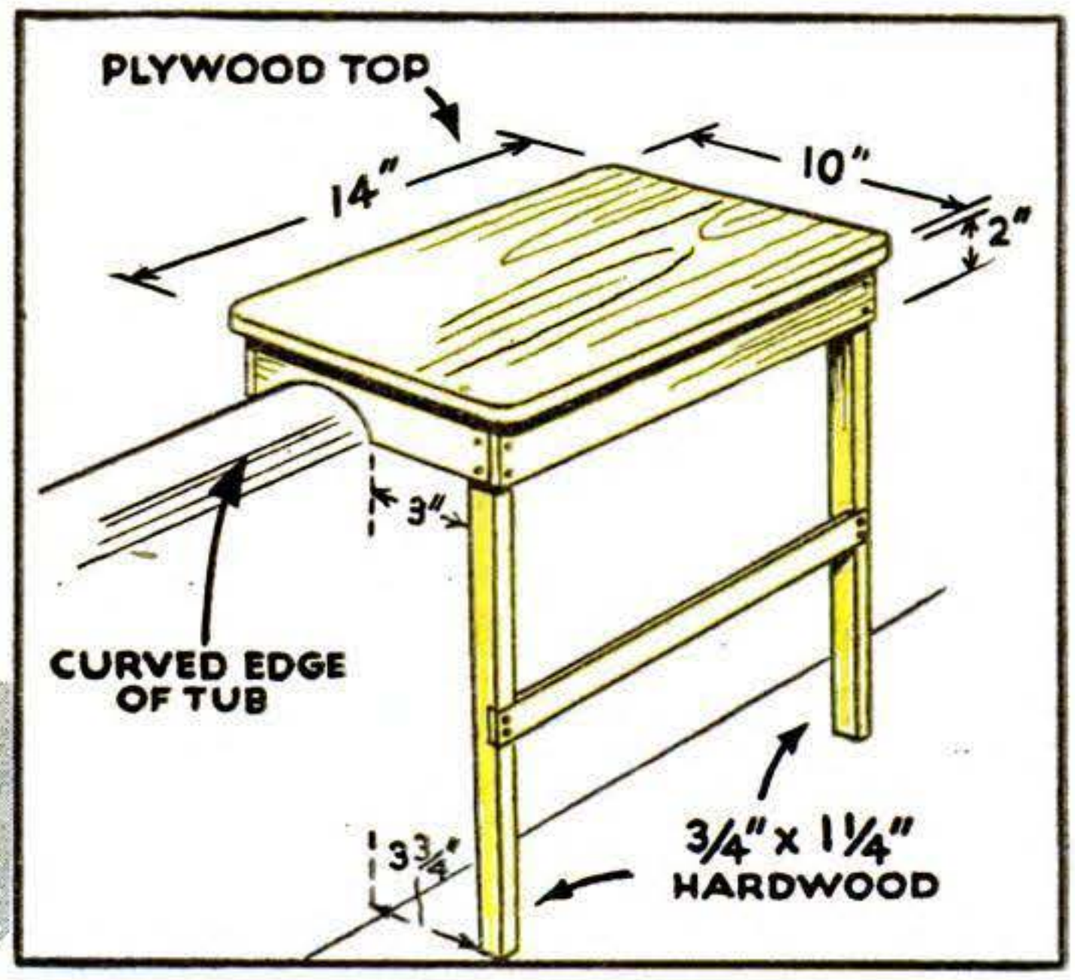
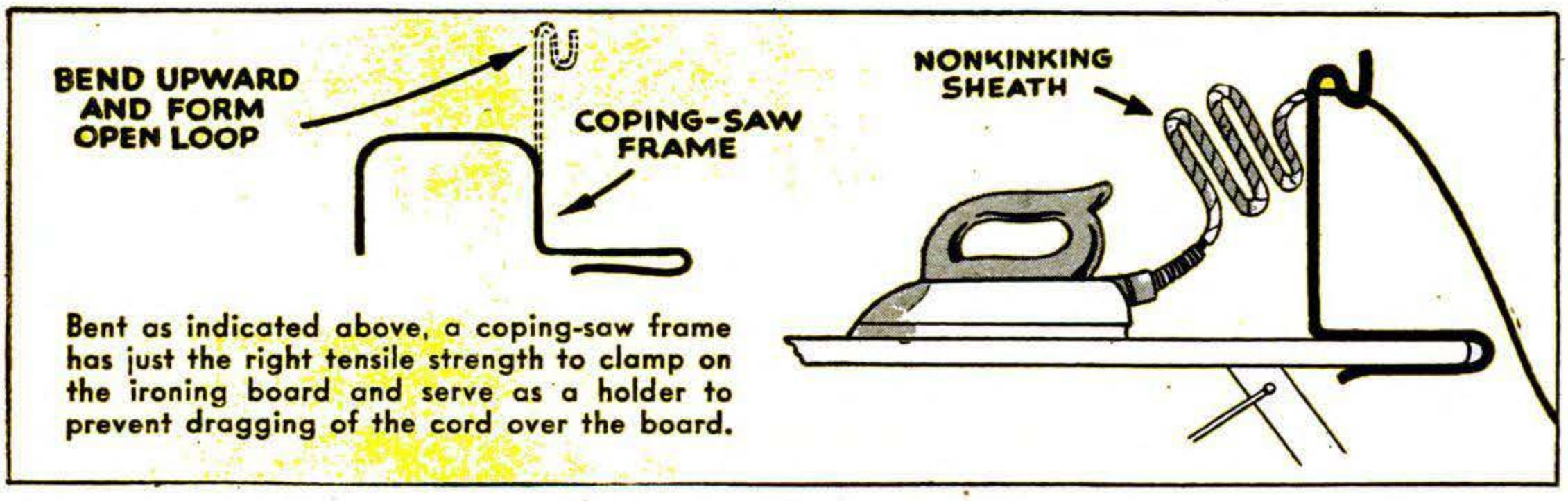
KEEPING

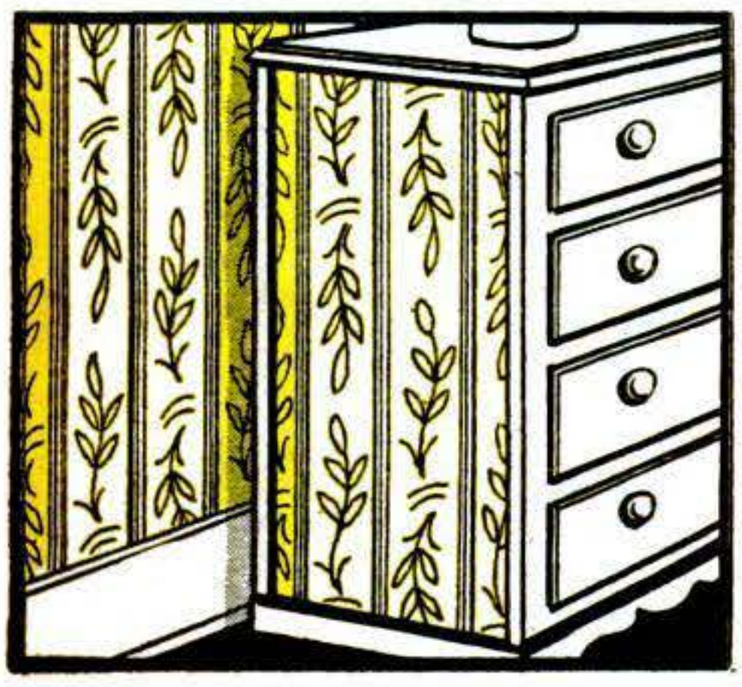


Whether you are in the tub, or out of it, this bath seat will prove convenient, for it works both ways. The notch that rests on the tub can be cut to a nice fit by bending bar solder over the curved edge to obtain a pattern for marking the wood. Cut to the height of the tub, the legs are angled out a little for stability.



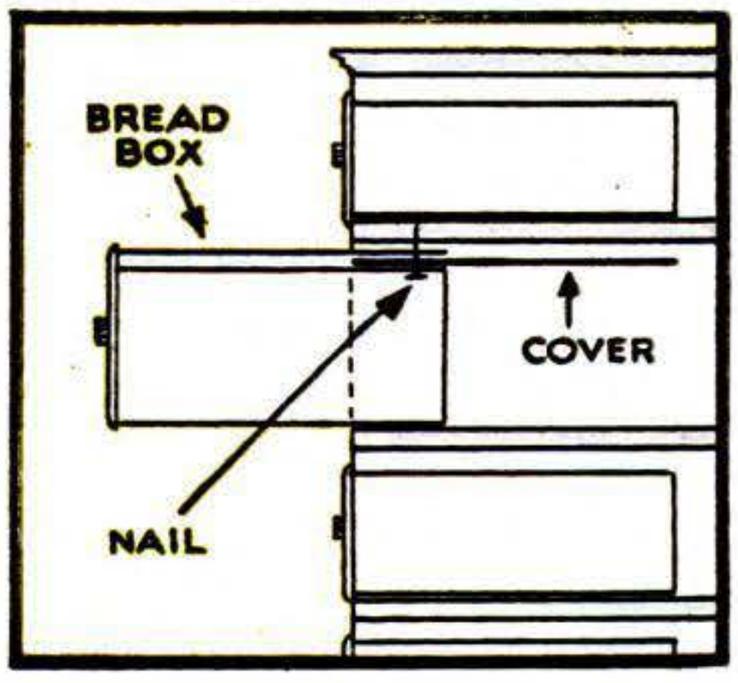
Bent as indicated above, a coping-saw frame has just the right tensile strength to clamp on the ironing board and serve as a holder to prevent dragging of the cord over the board.

If an old dresser or chest needs redecorating, the front and top may be painted or enameled and the ends covered with wallpaper matching that on the room walls.



One mother keeps the tongues of her child's shoes from slipping down by passing the laces through two small slits near the top of the tongue before tying.

Cabinet bread boxes with sliding covers will be more convenient if a nail is driven up through a vent as below. When the box is pulled out, the cover remains stationary.



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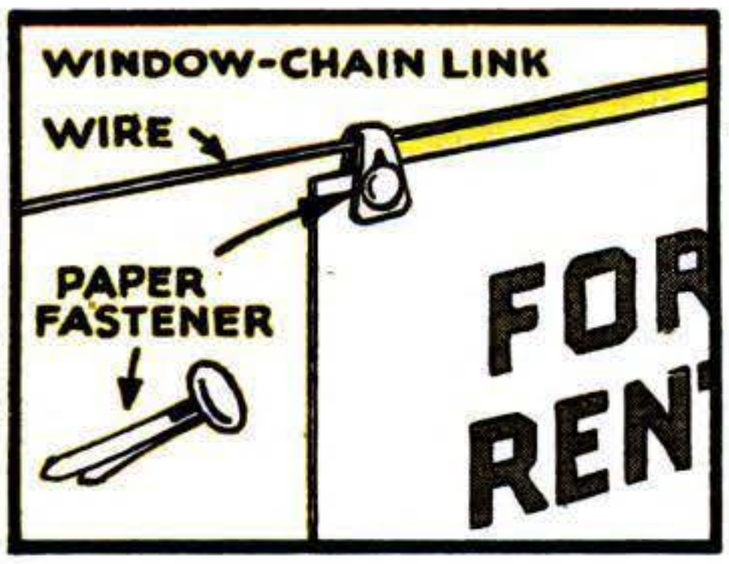
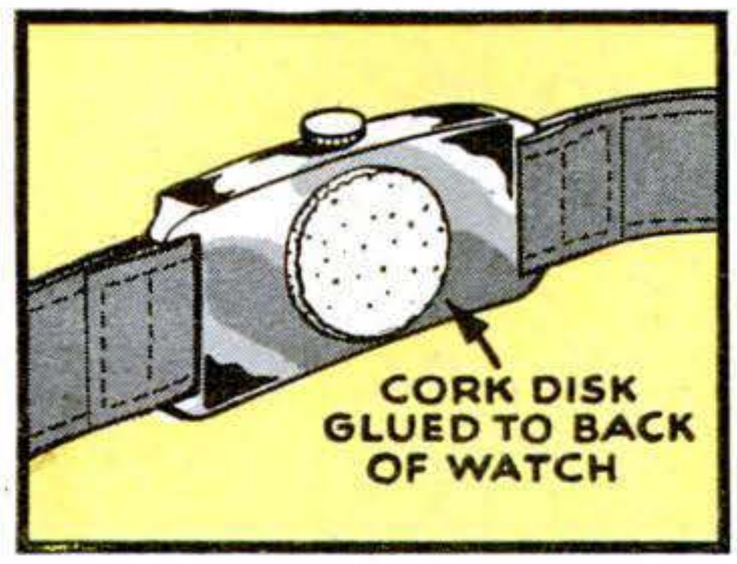
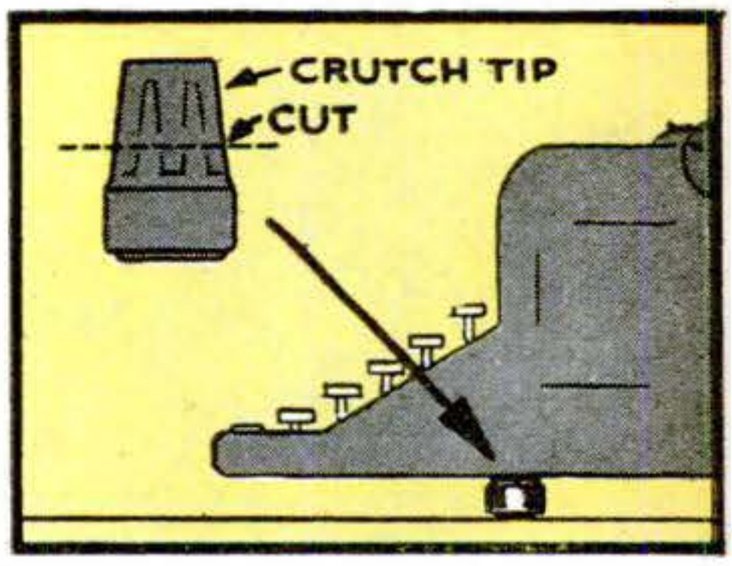
THE HOME SHIPSHAPE



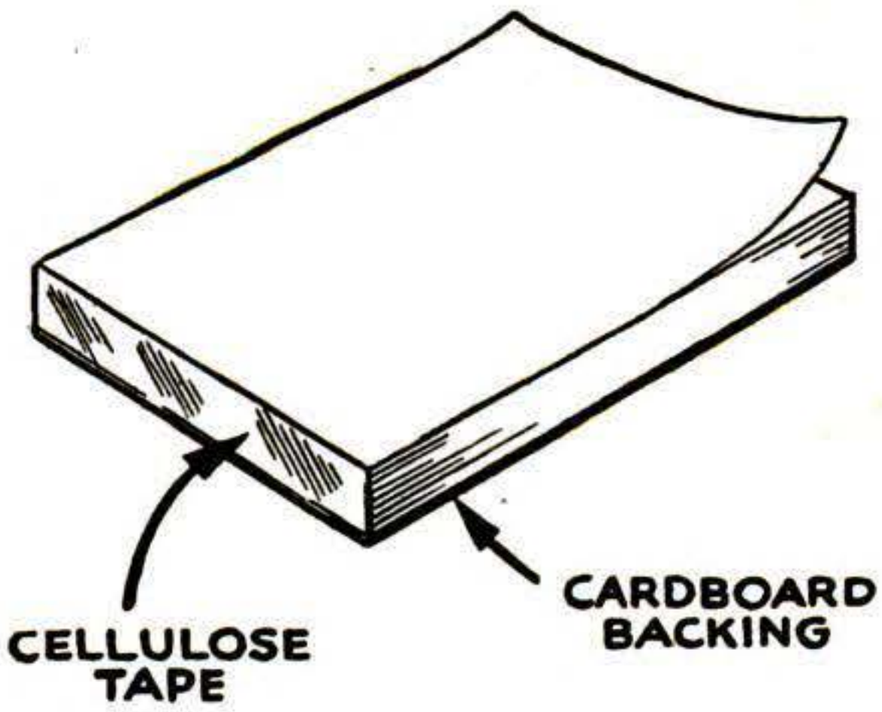
Window-chain links and ordinary paper fasteners provide an easy way of affixing a sign to a wire support. Slip the links over the wire, and staple to the placard.



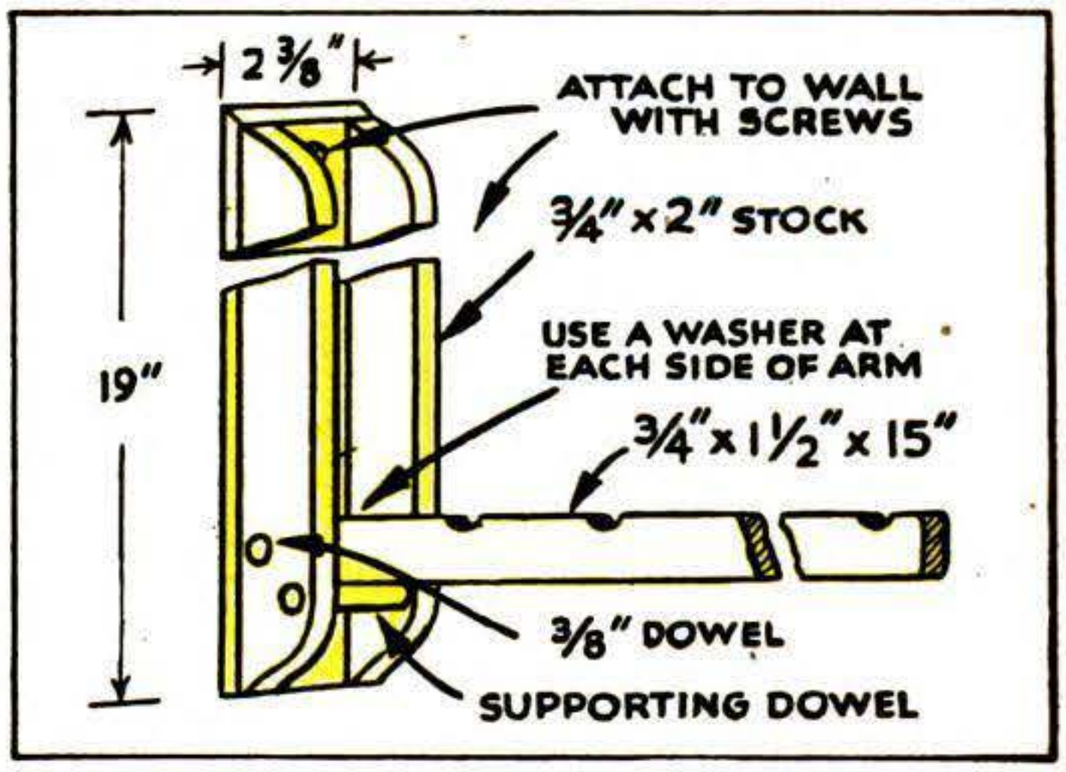
A thin disk sliced from a bottle cork and glued to the back of a wrist watch will keep the watch from slipping around on the arm. Cut the disk with a razor blade.



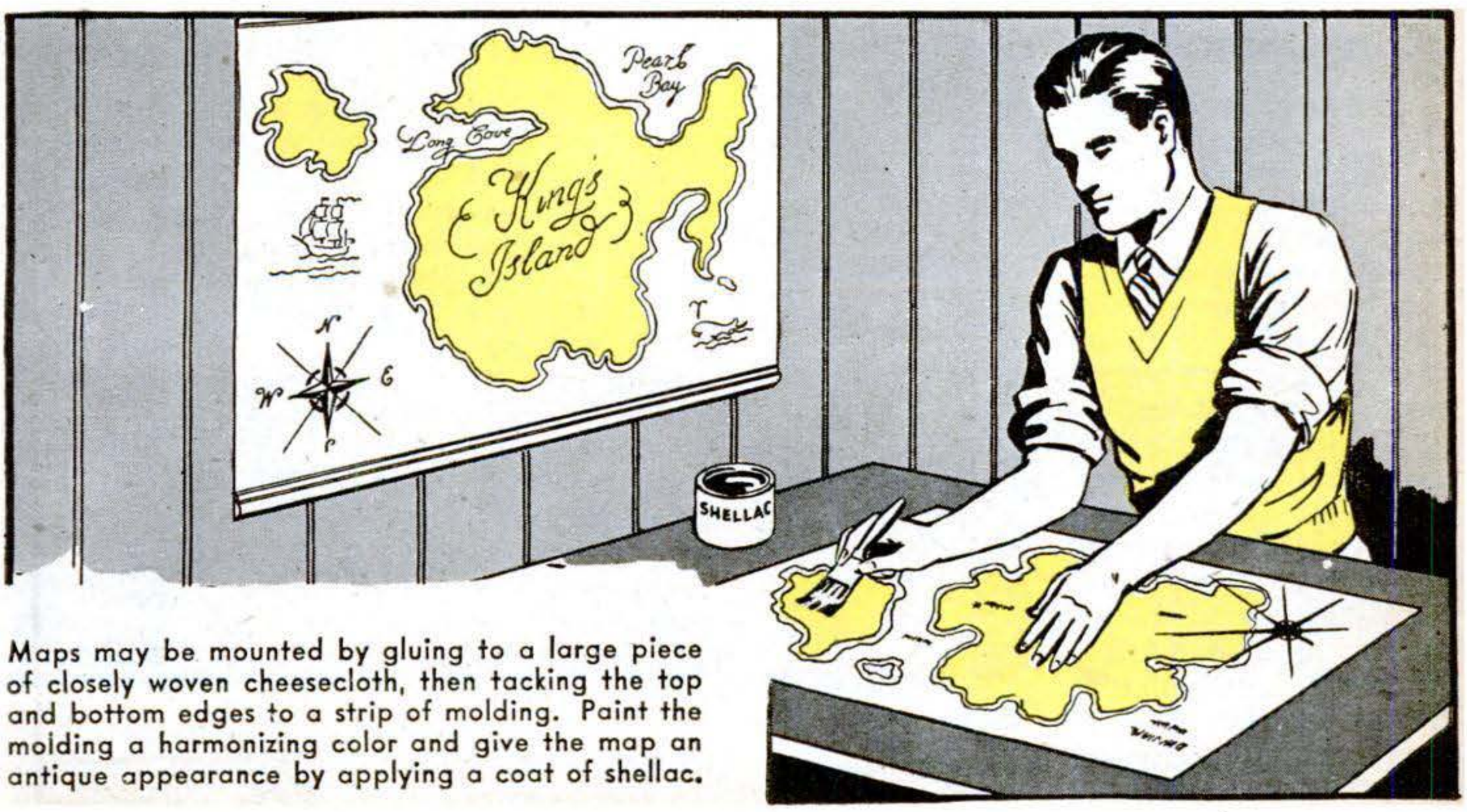
Rubber cups cut from crutch tips and affixed to a typewriter will prevent the creep and soundboard effect that often occur when the machine is used on a wood surface.



Loose scratch paper may be made up in pad form by applying cellulose tape to one end after jogging the sheets until they are even. Back the pad with cardboard and rub the tape hard so it will stick.



Most closets have space for one or more of these folding clothes hangers. When not in use, the arm may be swung up out of the way. Before attaching, locate a stud by sounding the wall with a hammer.



Maps may be mounted by gluing to a large piece of closely woven cheesecloth, then tacking the top and bottom edges to a strip of molding. Paint the molding a harmonizing color and give the map an antique appearance by applying a coat of shellac.

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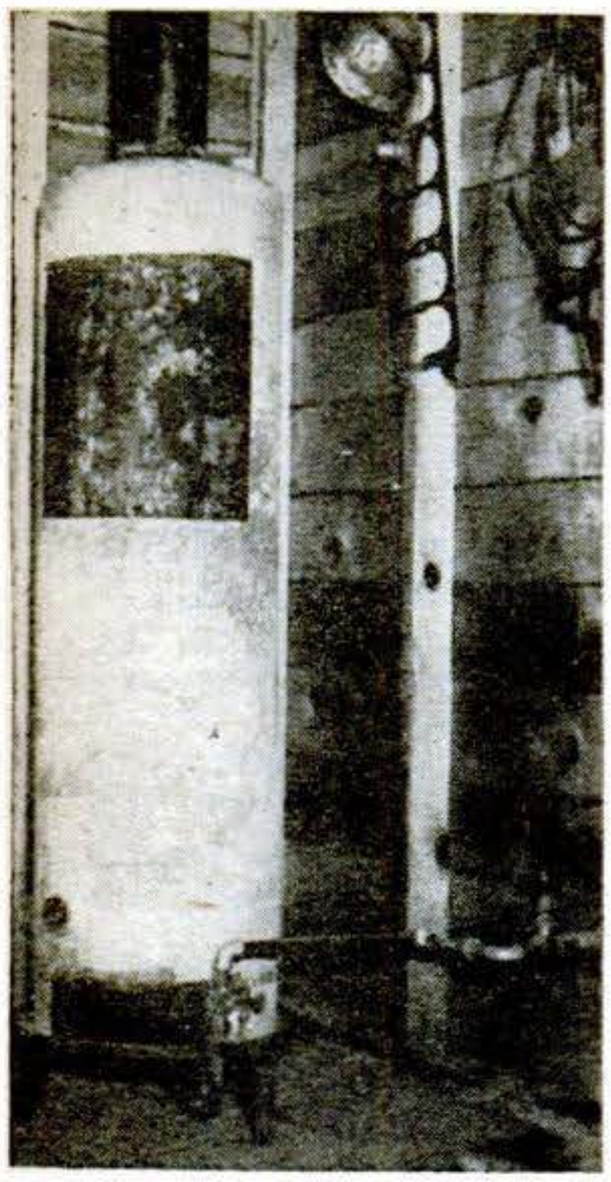
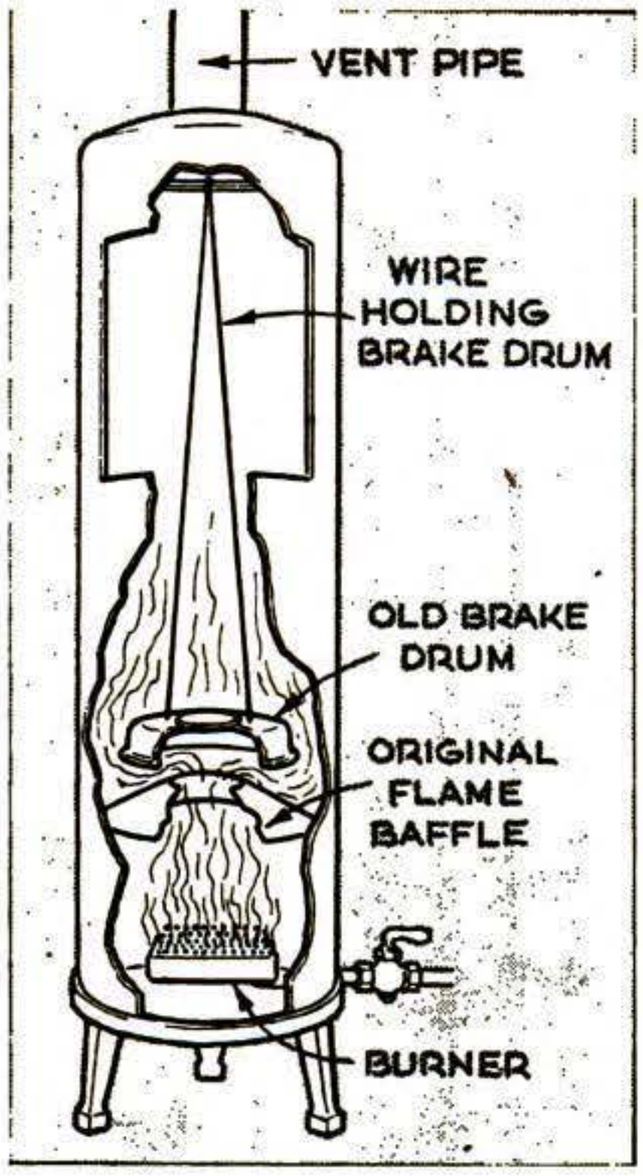
Converted Gas Hot-Water Heater Warms Small Auto Repair Shop



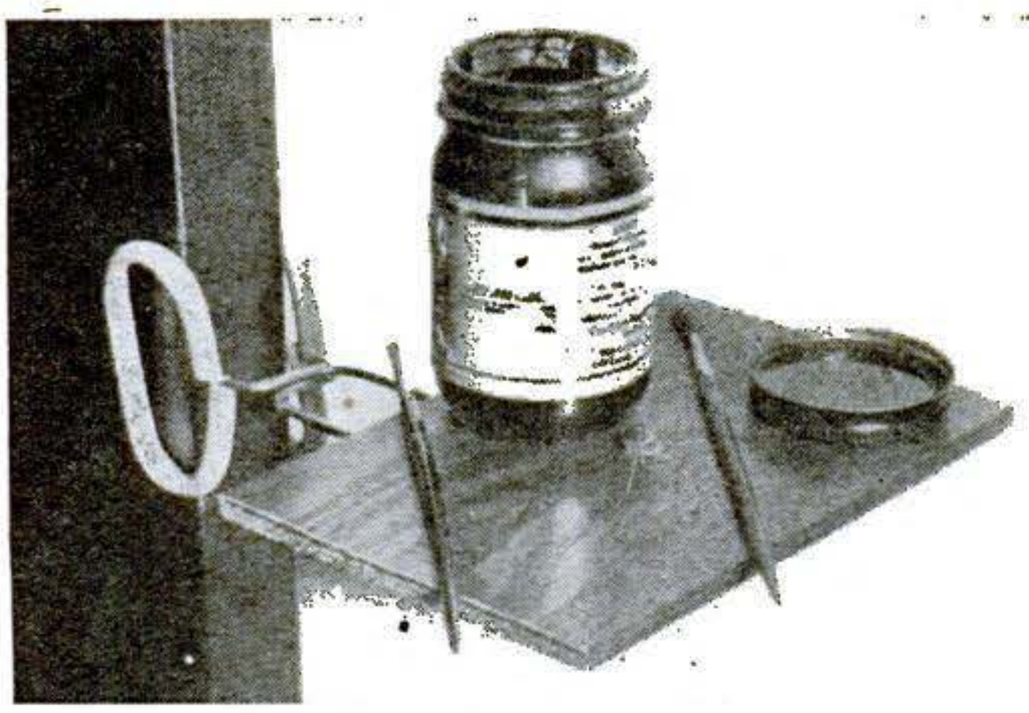


RADIATING heat like a pot-bellied stove, this old gas hot-water heater now provides all the warmth needed for a small automotive repair shop. The drawing indicates how it was converted.

All insulation was removed from the outside of the tank and a large oblong hole was cut in the side above the middle. After removal of the flues, the hole in the baffle was enlarged to a diameter of 8″ and an old brake drum was suspended with wire directly over it to spread the flames against the side of the tank. A piece of sheet metal was bolted over the hole cut in the side of the tank and a vent pipe was run outdoors from the top of the heater. The gas is regulated by hand, but a pilot light saves lighting the burner with matches.—E. S. HARRIS.

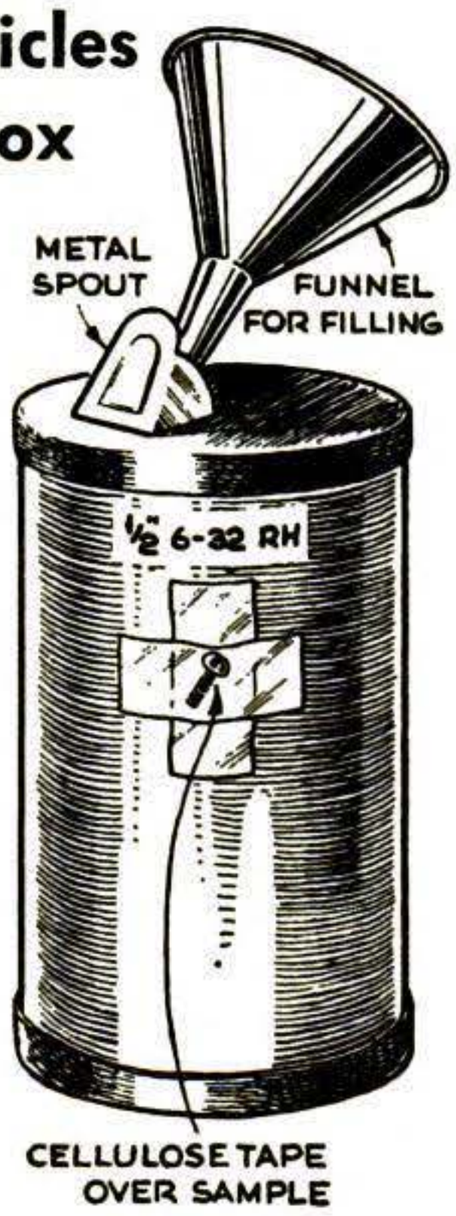
Clamp Tray Aids Sign Painter

SIGN painters who letter doors will find that the tray shown at the right will save them constant stooping to the floor to charge their brushes from the paint container. It was made by bolting a piece of wood to a clamp taken from a portable lamp. Clamped to the edge of the door at the height of the work, the tray is sufficiently secure to withstand the weight of one or two small jars of paint and the necessary brushes.—HERMAN KLEIN.



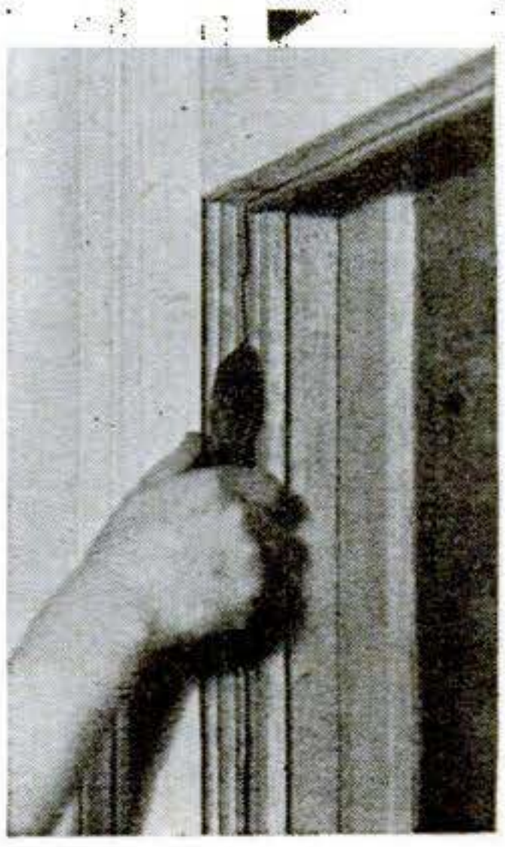
Many Small Articles Stored in Salt Box

CYLINDRICAL cardboard boxes in which table salt is sold will serve as convenient containers for storage of many small objects in the garage and workshop. The boxes can be filled with a funnel, and the metal spout makes it easy to remove just a few parts when they are needed. The contents can be indicated by attaching a label and sample to the outside. Such boxes are useful for screws, rivets, or tacks.—R. H. DAVIS.



Weatherstrip Holds Window

WHEN a window keeps falling away from its raised position because the sash weight is not sufficiently heavy, the difficulty can be quickly overcome if the window happens to be equipped with weatherstripping of the metal type that fits in a groove. Make one or two slight kinks in the weatherstripping with a pair of pliers as illustrated at the right. These kinks will provide just enough friction to prevent the window from falling but will still allow it to be raised or lowered.—H. SCHLOSSBERG.



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Announcing the Winners of Our

BOAT CONTEST

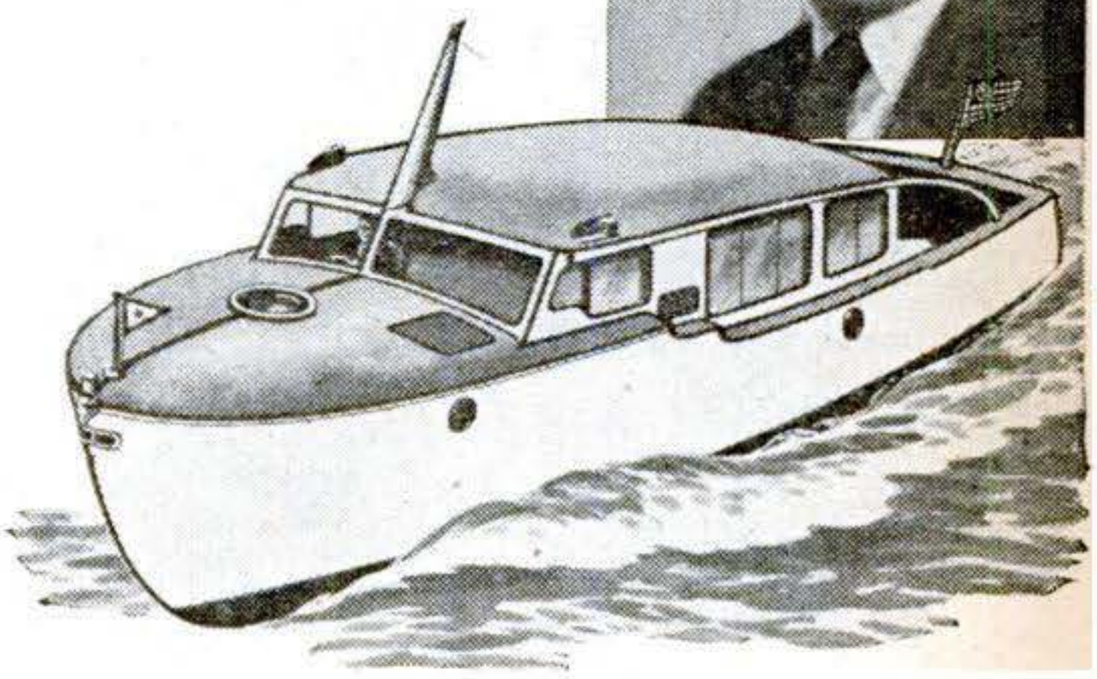
EVERYBODY wants to own a boat, judging from the entries in our boat contest. Designs were received from all over the country, from Canada, and from Europe. There were boats made of wood, plywood, molded plastics, and steel. Utilitarian houseboats, graceful sailboats, Diesel and gasoline-powered motorboats, and jet-propelled high-speed hydroplanes all had their adherents.

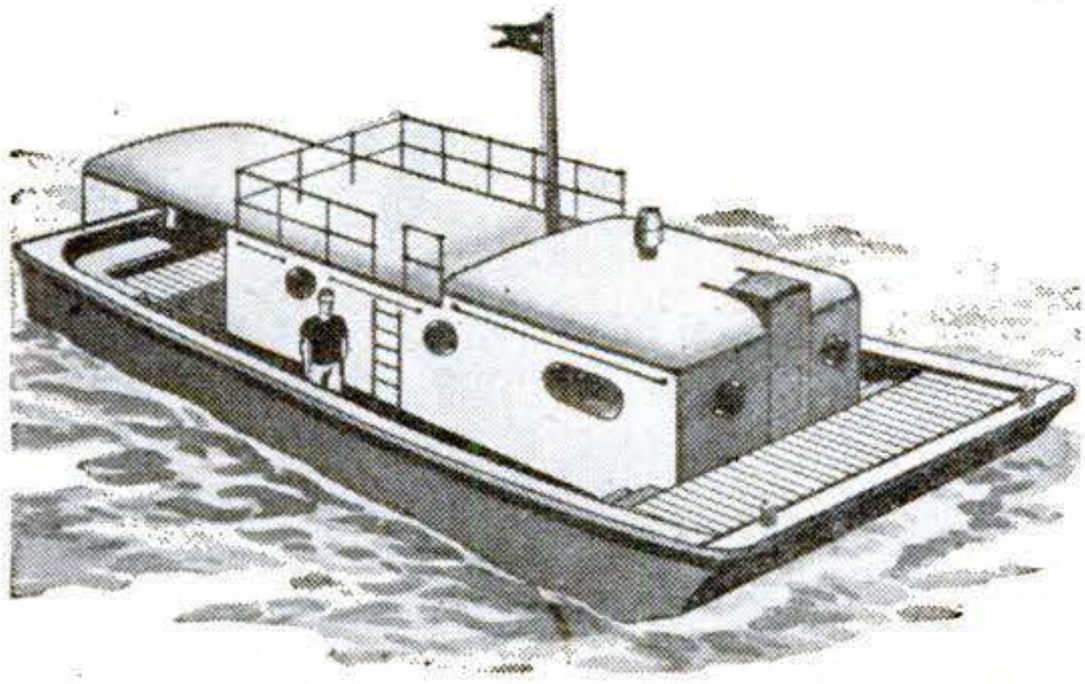
Among the more unusual were three sailing catamarans, an amphibious automobile, an auxiliary with sails that looked like airplane wings set on end, and an electrically propelled houseboat with a wind-powered generator.

The six principal prize winners, though widely divergent in type, all have one thing in common—they are practical craft that can be built today. Four are shown in the accompanying photos.

1st PRIZE. This V-bottom cruising sailboat was designed by Ens. Paul Edward Tay. It could be built by an amateur. Materials might cost $500.

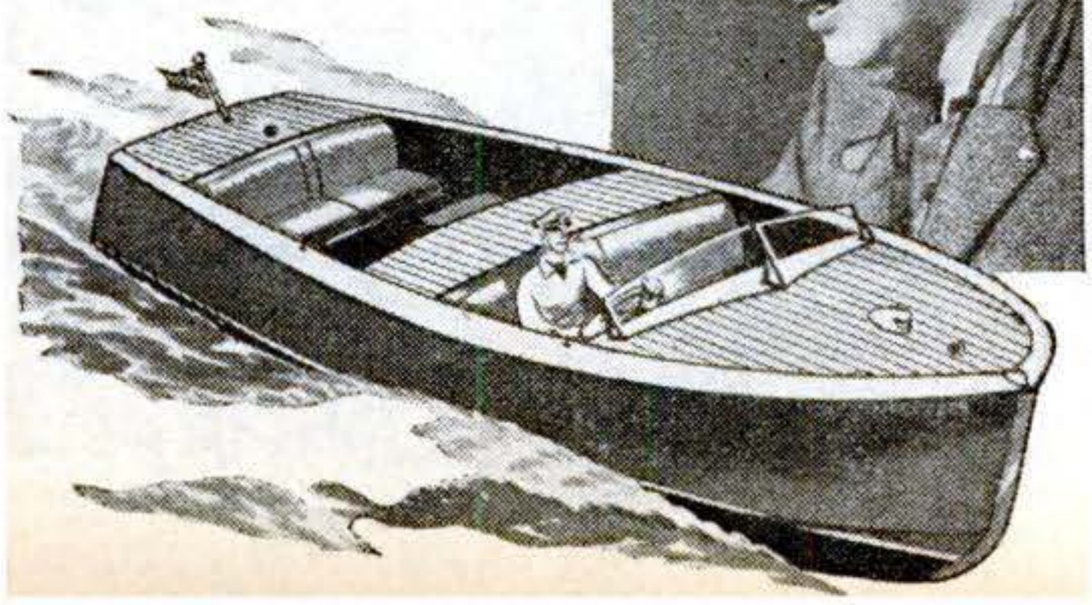
2nd PRIZE. Laurence F. Coburn has his heart set on a sleek twin-screw steel cruiser powered by pancake-type engine. If built on an assembly line, its price might be $3,200.





3rd PRIZE. If J. A. Delinks has built and is living on his houseboat *Seclusion,* will he wire us where it's anchored? He furnished no address.

4th PRIZE. Pvt. Robert E. Higgins wants a runabout. With a Mercury engine, it may cost him $740. He plans to do his own building of the boat.



LIST OF PRIZE WINNERS

1st Prize: Ens. Paul Edward Tay, Corpus Christi, Texas.

2nd Prize: Laurence F. Coburn, Michigan City, Ind.

3rd Prize: J. A. Delinks (no address given).

4th Prize: Pvt. Robert E. Higgins, Akron, Ohio.

5th Prize: F. W. Coyle, Sunderland, England.

6th Prize: Louis Langbeen, Michelen, Belgium.

Honorable mention: William P. Carl, Jr., Baldwin, N. Y.; Bob Butterfield, Mansfield, Ohio; W. G. Stuart, Jamaica, N. Y.; Noel Lamoureux, Montreal; Ens. D. W. Carnell, USS John Rodgers; D. D. Muzzy, East Elmhurst, L. I.; Sydney M. Smith, Toronto; George W. Fabrin, Berkeley, Calif.; William J. Chmiel, New York; Pvt. Roger Engel, Camp Blanding, Fla.

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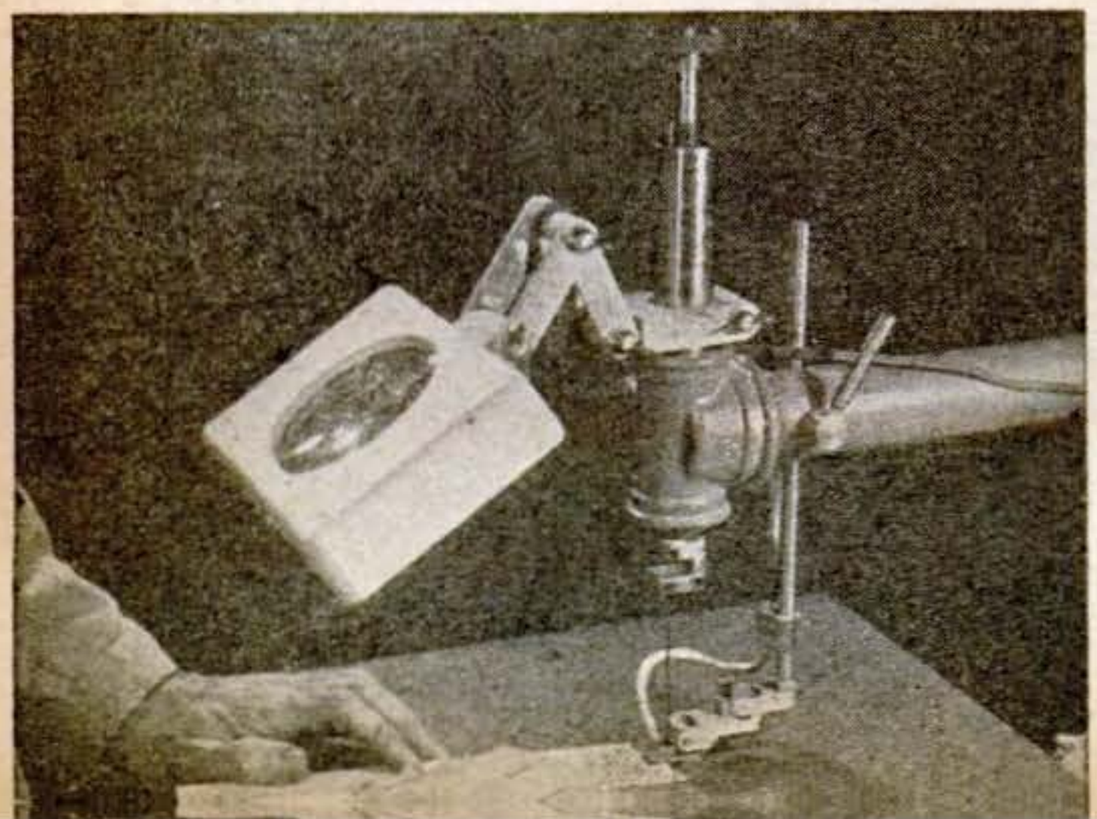
Shadowless Magnifier Lightens Your Work

By Frank McCarty

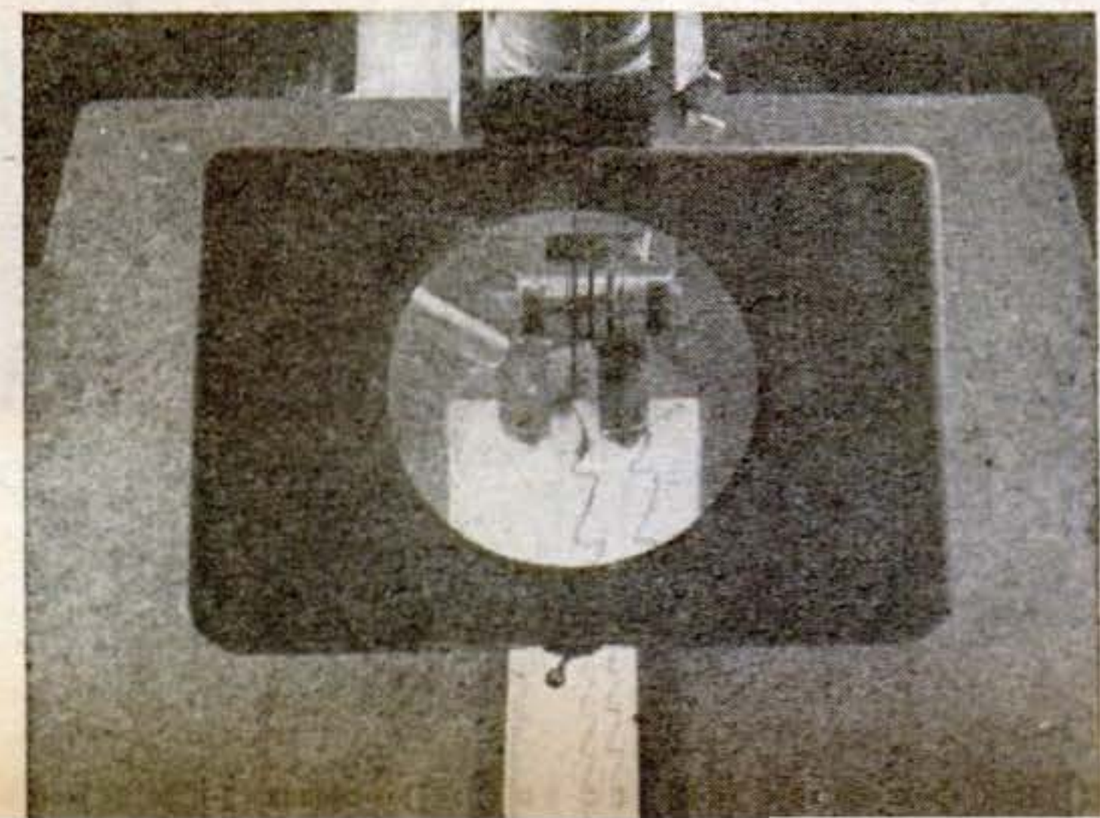
SERVING a double purpose in the workshop, this illuminated magnifier can be used on a bench stand for delicate hand work, or attached to a jigsaw or other tool so that fine markings may be followed accurately and without eyestrain. The lens used here was salvaged from an old reading glass, but any old or new lens approximately 4" in diameter and giving suitable magnification will serve for this purpose.

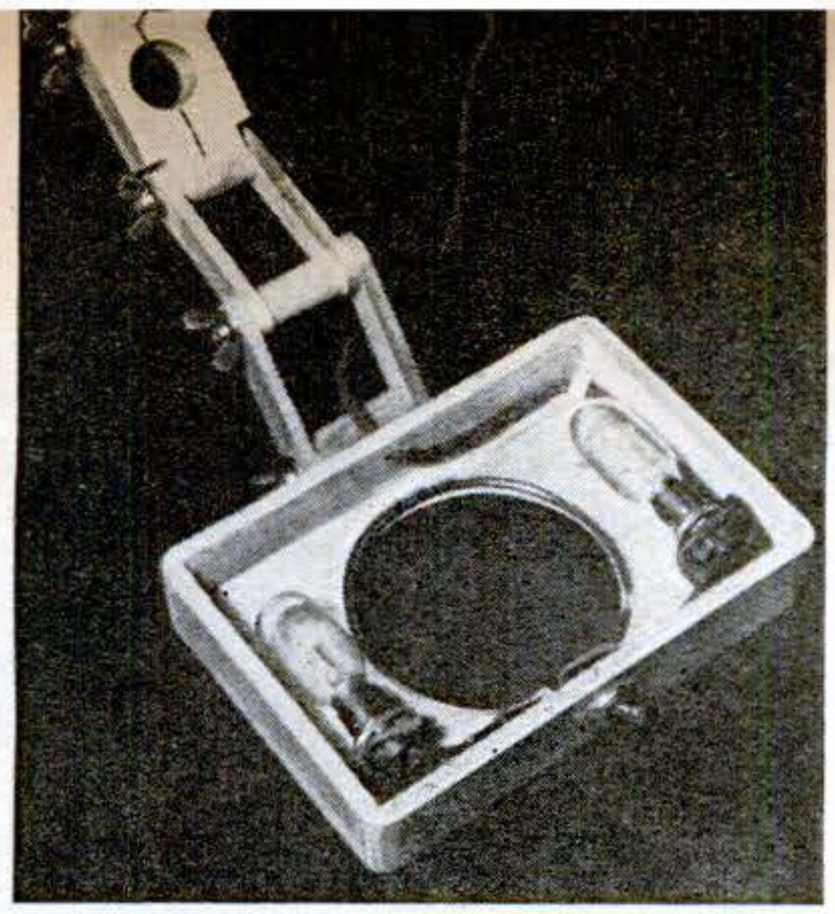
To make the housing, cut a top and four sides to the dimensions indicated in the drawing. They may be made of almost any wood. Before assembling the pieces with glue and brads, mount the top in a lathe and turn it half through from the back until the lens fits snugly. Taper the hole slightly inward so it will hold the ⅛" spring-wire lens retainer. Reverse the wood on the faceplate, and turn a recess of slightly lesser diameter, concentric with the first recess. Leave a paper-thin partition between the

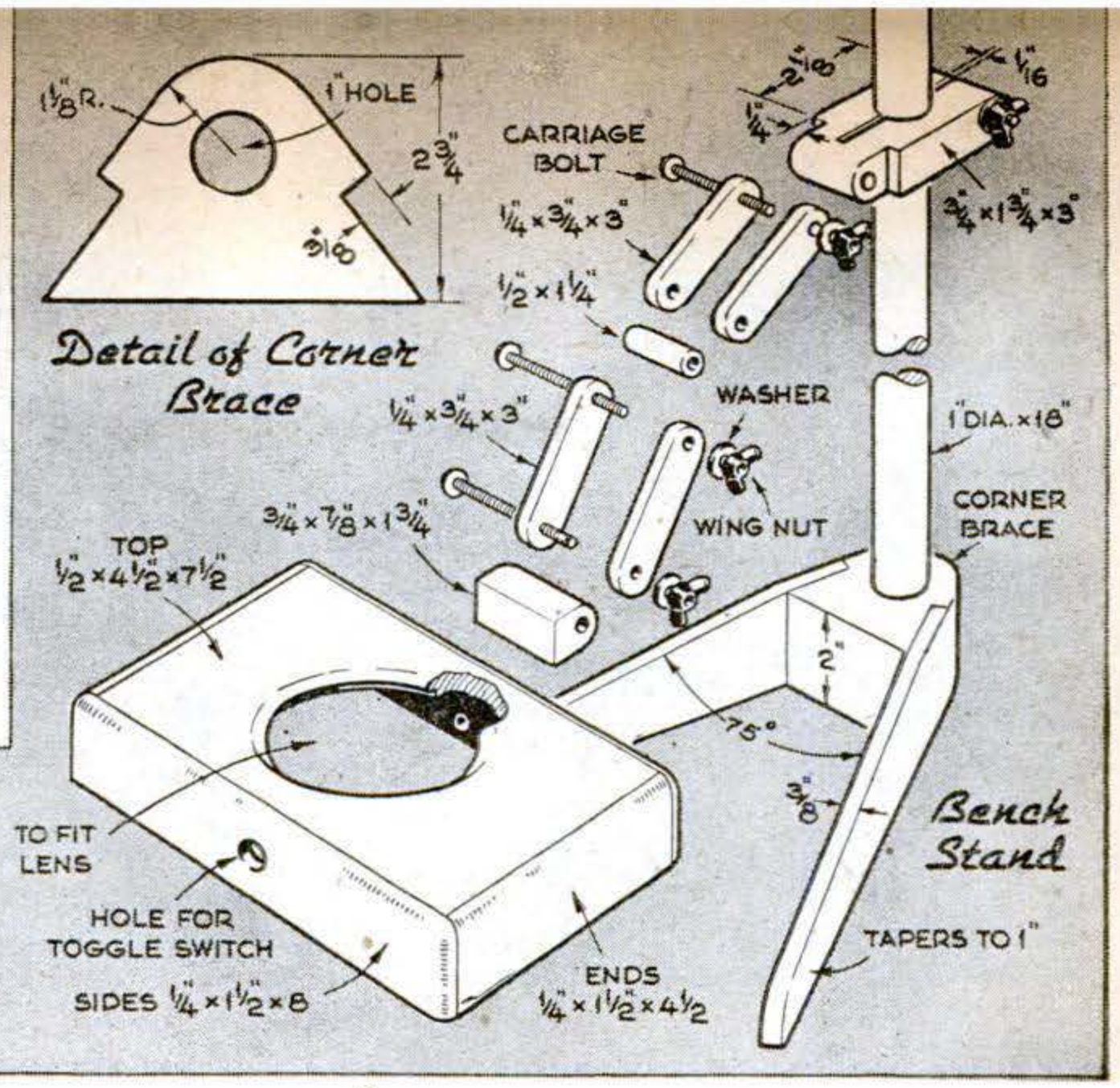
The bench-stand clamp fits over this jigsaw post, but for some tools an extra bracket may be needed.

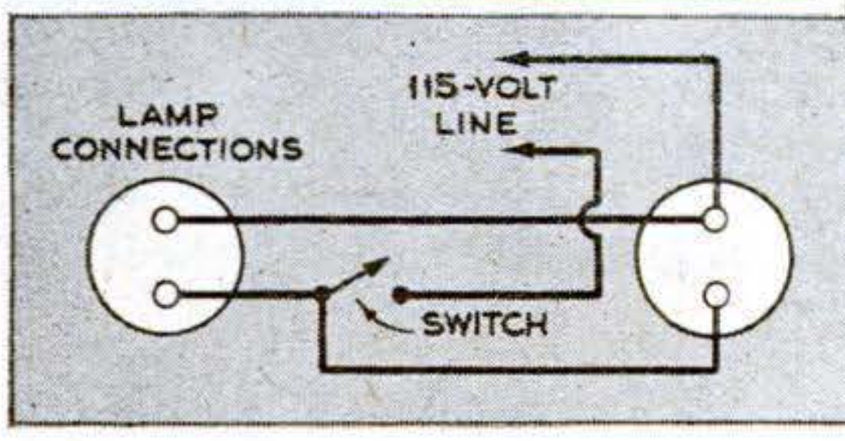


Seen through the magnifier, markings on the illuminated work are large enough to be followed easily.









two. Then pare this wood away with a sharp knife.

Glue a block of wood to the back of the case, and piece together the rest of the jack-knife bracket as shown. In order to use the magnifier on a machine tool, it may be necessary to make an extra clamp with a hole of proper size to fit on some part of the machine.

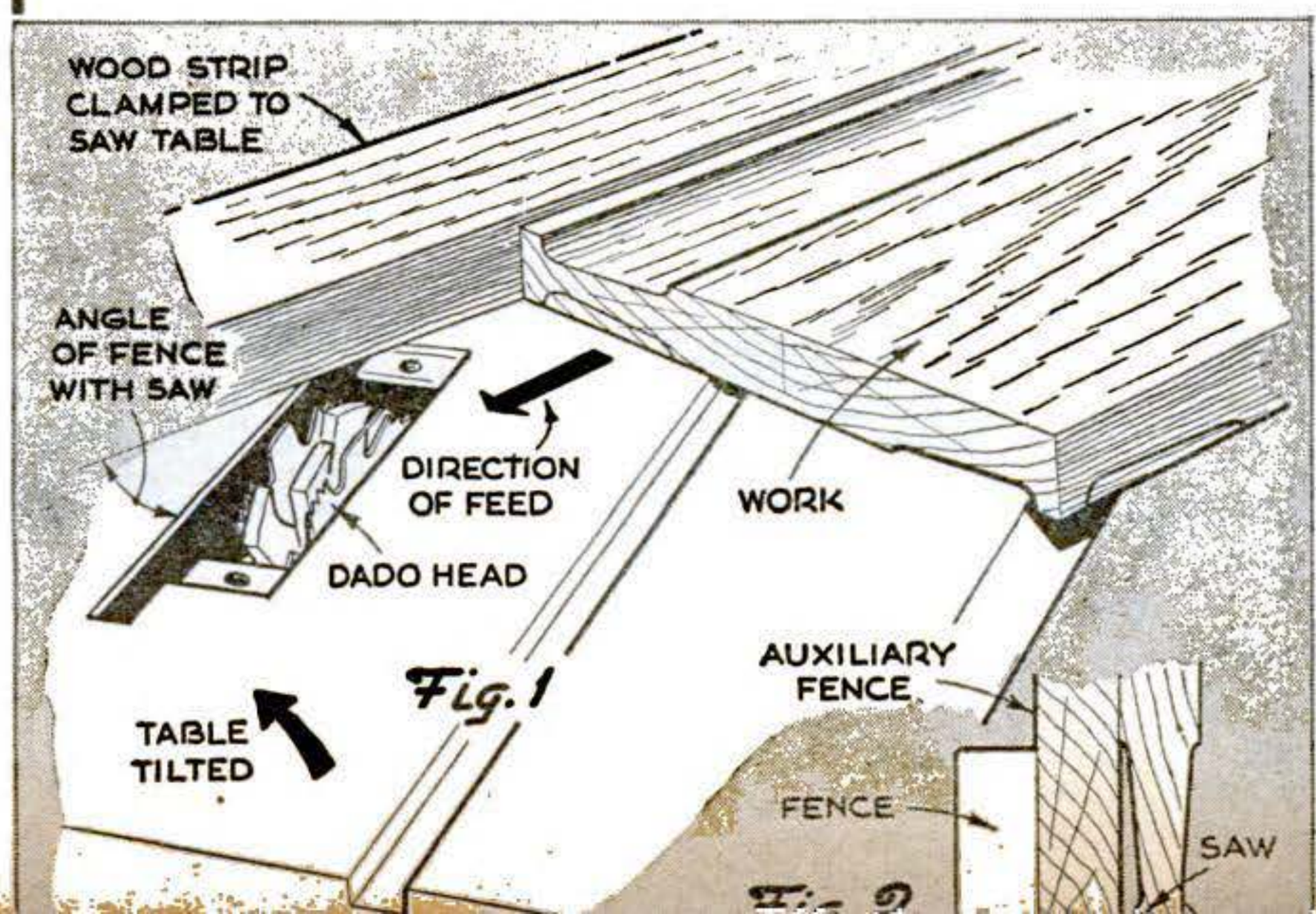
Wire two bayonet sockets in parallel as shown in the diagram, using a toggle switch to interrupt the circuit. Suitable sockets may be obtained from old automobile-headlight reflectors. Make sure they are of the high-and-low beam type, with two contact buttons on the bottom. Simple wood or metal brackets may be used to fasten them in place. Use insulated staples to secure the wire around the inside of the case. A pair of 25-watt bayonet bulbs, rated at 115 volts to work on house current, will give adequate light for most of your shop needs.

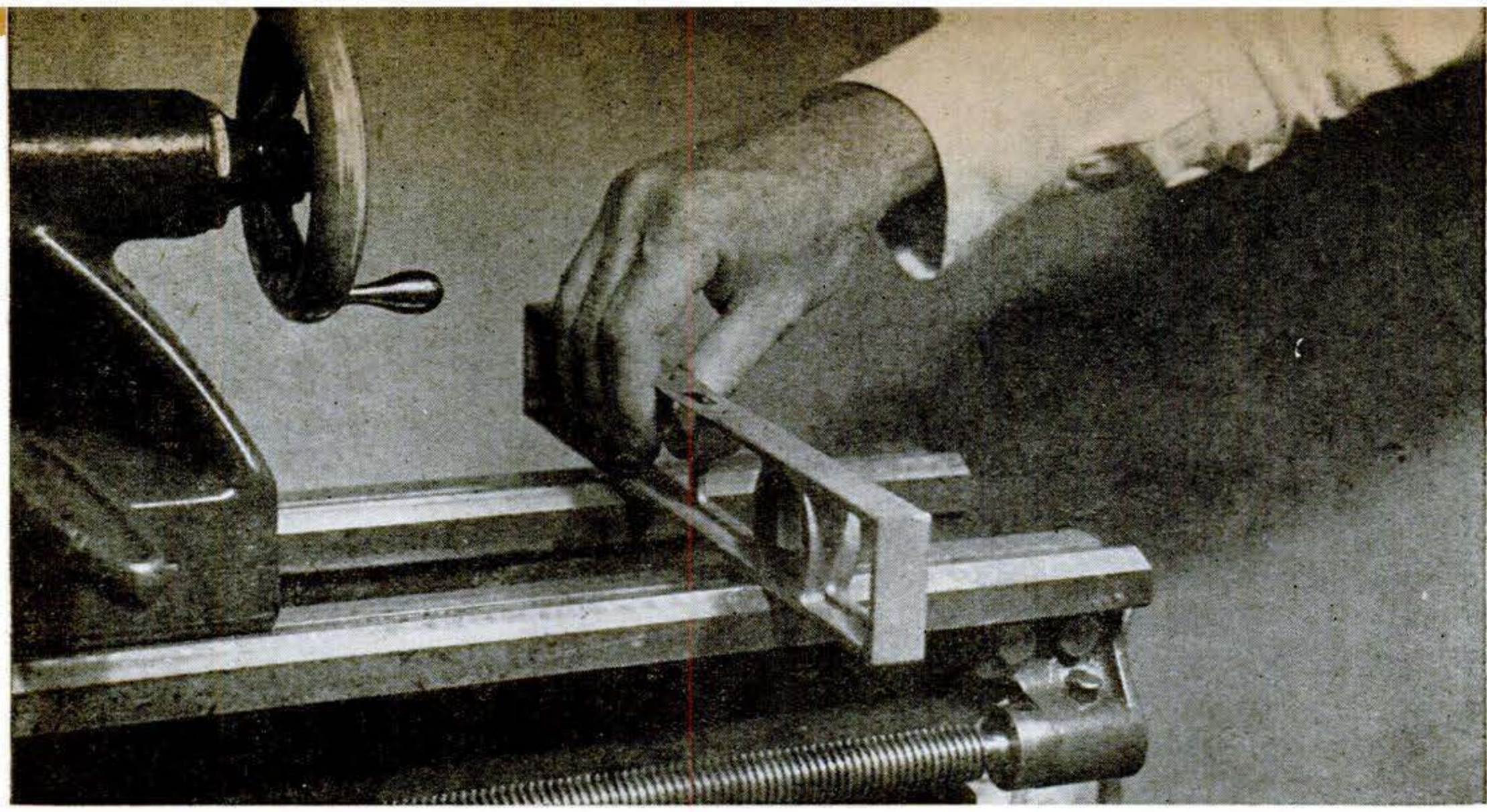
Panel Raising with a Circular Saw for Fine Cabinet Work

RAISED panel effects, such as are used on doors and cabinets, can be produced by thinning the edges of standard-stock panels. While special shaper equipment is generally used in large shops, the job can also be done with a dado head mounted in a circular saw.

Tilt the saw table slightly more than the slope of the border desired, and adjust for depth of cut. Clamp a fence strip to the table at an angle with the saw. The greater the angle, the smoother the surface produced. This angle also regulates the bevel and edge curvature of the raised portion. Test on scrap lumber.

To make the cut narrower, remove some of the chippers; for greater width, shift the fence after the first cut, reset the saw, and repeat the operation. Leave a ¼" to ⅜" flange which can be ripped off as shown in Fig. 2. The parallel edges fit the frame grooves.—EDWIN M. LOVE.





Pointers on Buying a Used Lathe

SCREW-CUTTING lathes are probably the most versatile of machine tools, and most home workshop enthusiasts hope some day to own one. With the end of war production and the probable release of numbers of surplus lathes, some in sizes suitable for home use, that day may be near for many amateur machinists.

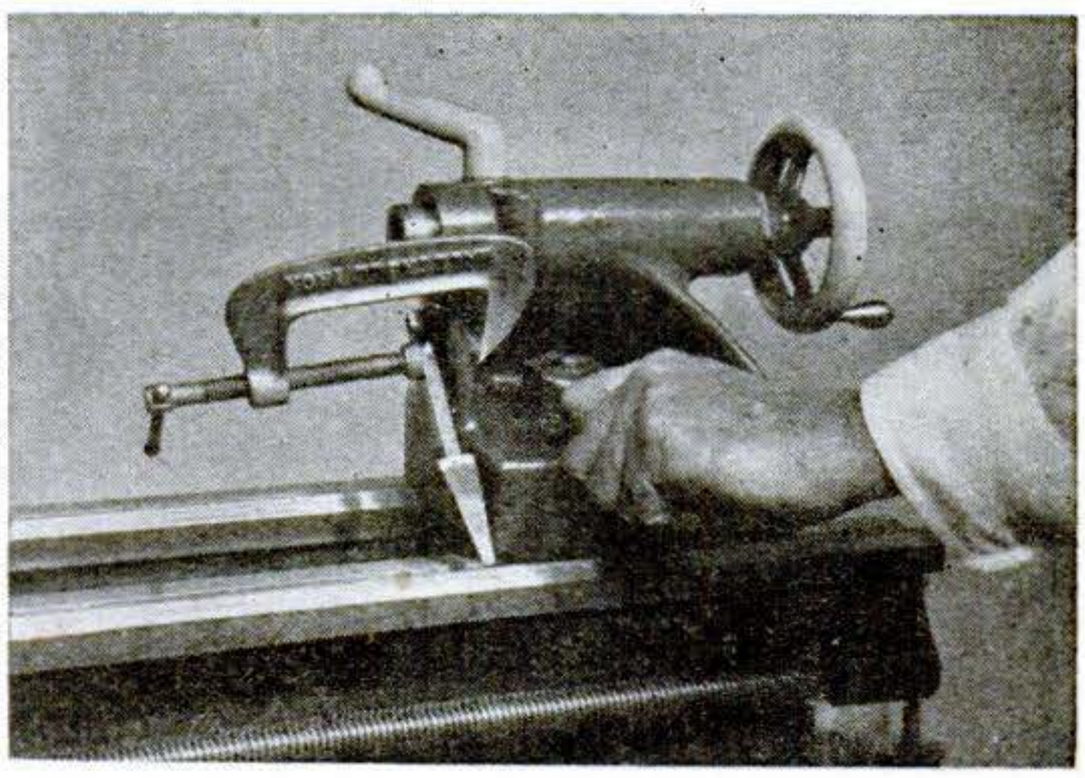
In buying a used lathe, you will want more than shiny metal and a good paint job. Some mechanical defects, however, are more serious than others. Many parts, such as lead and cross-feed screws, nuts, and collars, can be replaced at nominal cost.

The backbone of the lathe is the bed, and this should be examined first. Check for twist with a machinist's level; even so delicate an instrument as the cabinetmaker's level shown used above may not register slight misalignments. Try the level both at the extreme tail end and near the headstock. Some variation may be caused by improper mounting, so use shims if necessary to level the bed for the next tests.

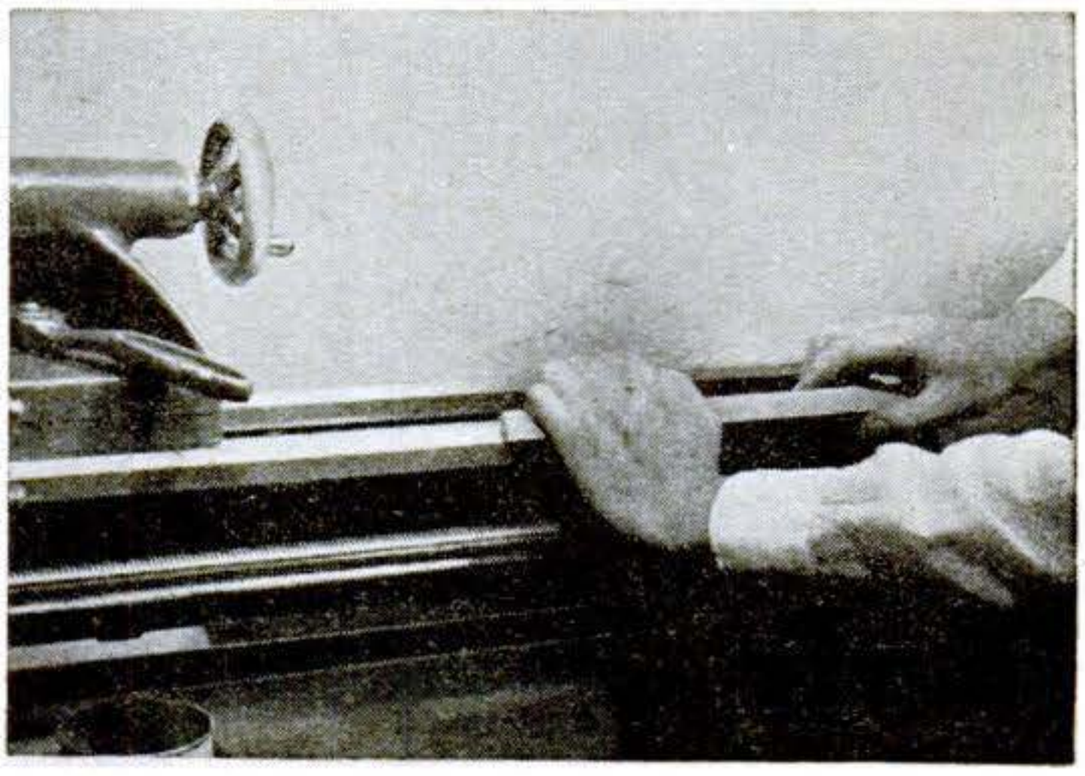
Nicks and scratches in the ways are not serious, and a smooth finish does not always mean absence of wear. Clamp a dial or exposed-type indicator on the tailstock with the indicating finger at right angles to the way being checked, clamp the tailstock at various points, and note the difference in readings, which should not exceed .004".

To check the headstock bearings, clamp the indicator in the toolpost so it bears on the live center (first wipe the center and the spindle hole clean, and check the center to see that it is in good condition). Then rotate the spindle, watching the indicator. The reading should not vary over .001" if the center is true and the spindle straight.

With the indicator still in position, pry the spindle to one side with a wooden bar. Movement of the indicator denotes play and should not be more than .002". Excessive play sometimes can be corrected by tightening the headstock fastenings to the bed,



An indicator on the tailstock shows wear on ways.



High spots on the ways are filed down carefully.

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replacing ball bearings, or adjusting tapered-roller or plain headstock bearings. Also check the back gears to see that they are not badly chipped.

See that the tailstock center is aligned with that of the headstock. It may be, when a shop has had several lathes, that tailstocks have become mixed and the correct one is on another machine. If a match cannot be obtained, shimming or filing may be necessary. In checking center alignment, clamp the indicator in the toolpost and adjust the finger to bear on the top of the live center. Without disturbing the indicator, place the same center in the tailstock, which should be set on center horizontally as shown by the witness mark on the base, and move the tailstock up so the finger will bear similarly on the center.

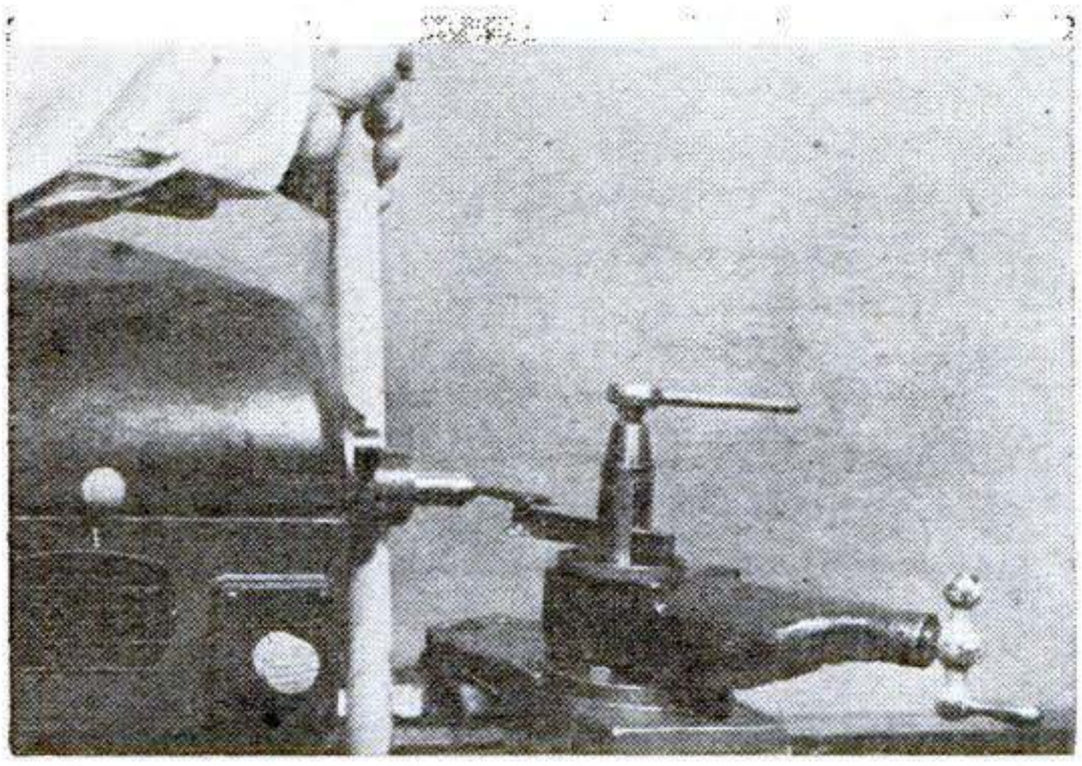
Examine the feed gears and, if they are not the quick-change type, check those listed inside the gear cover against those furnished to see that the set is complete.

With care, it is even possible to true worn ways. With the indicator mounted on the tailstock, try it every 3″ and write down the readings. File the high spots with a smooth mill file held flat against the way, carefully reducing these points to within .0005″ of the lowest part; then hone with a fine oilstone. If there is no provision for adjustment, looseness of the carriage on the ways can be corrected by filing the part of the carriage against which the retainer strip fits. Both the front and rear should be adjusted so that there is neither drag nor play.

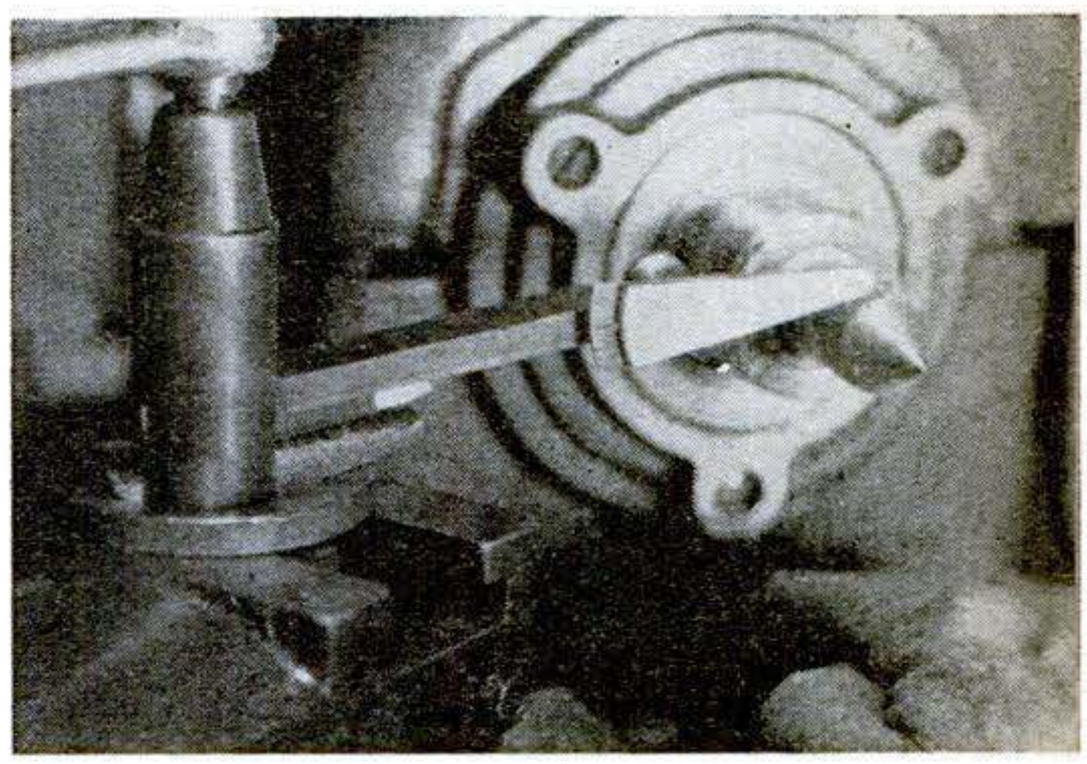
Before filing the bottom of a high tailstock, check with the indicator at the top of the center with the center fully retracted and fully extended to see that the sleeve is parallel with the base. If it is not, a little metal can be filed off.

Write the manufacturer for instructions on adjusting sleeve-type headstock bearings. If shims are provided, an equal number should be removed from each side. Loosening the clamp screw on a lathe with a bearing cap that cannot be removed will permit pulling out the shim for peeling.

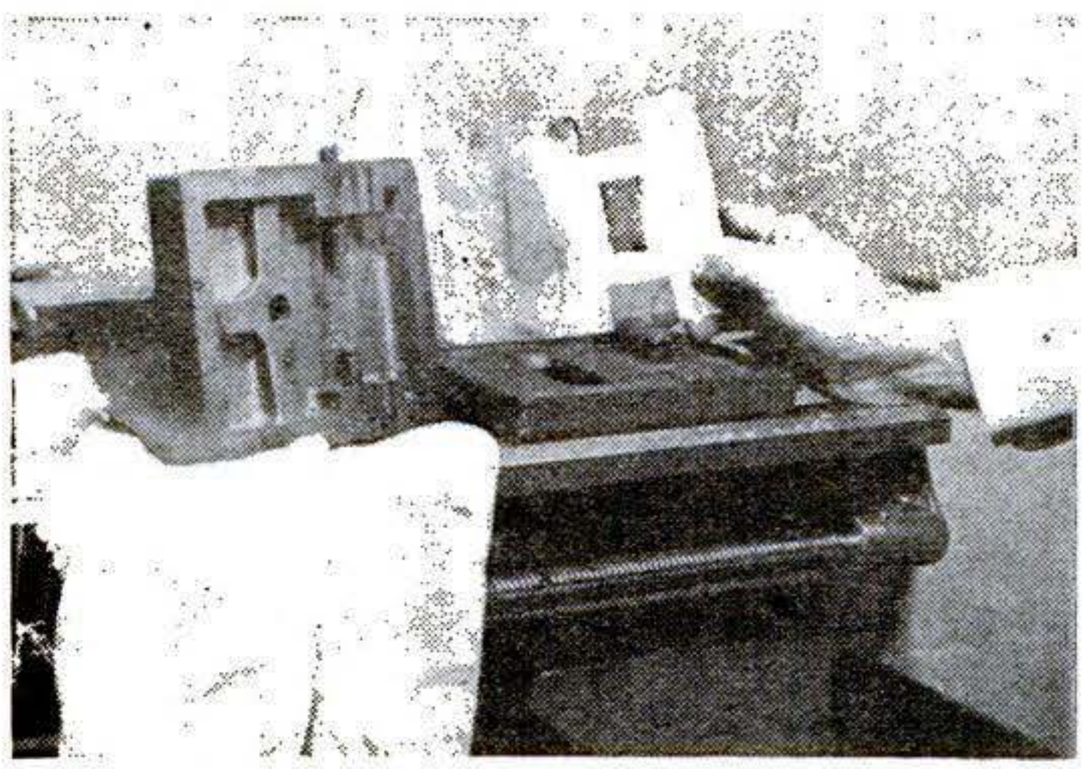
Gibs holding the cross slide and compound-rest slide in the dovetail may be adjusted by loosening the lock nuts and drawing up the screws to prevent play without binding. Dismantle the parts first and clean them. Coat them with motor oil after assembling, and check the adjustment by running the slide from one extreme to the other. Adjustments are provided for the feed screws, but a little end play will cause no trouble.—W. E. L.



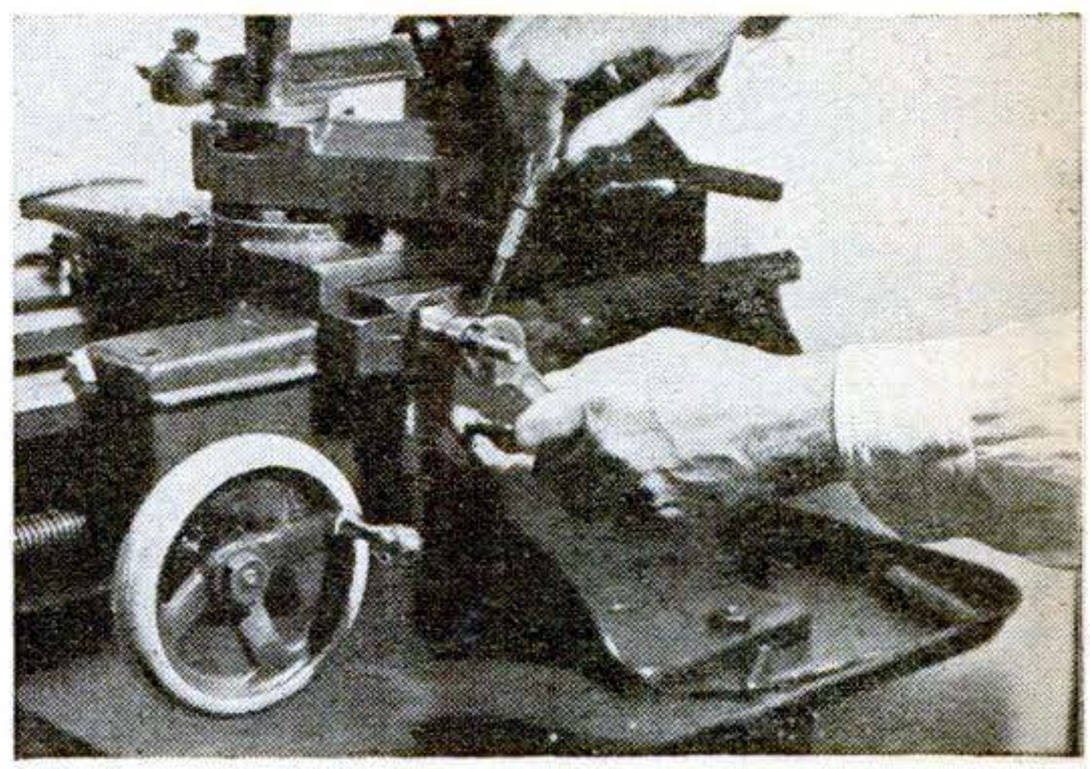
Prying on the spindle checks for loose bearings.



One center tests headstock and tailstock alignment.



A low tailstock is aligned with a shim like this.



Take out excessive end play in a cross-feed screw.

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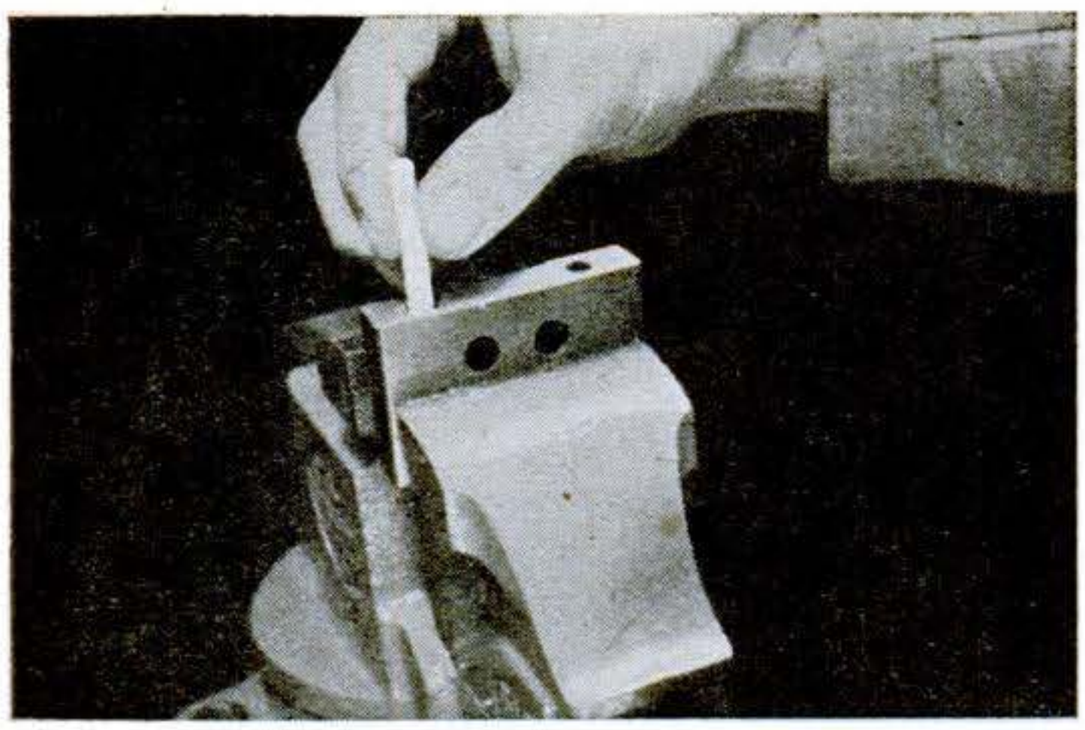
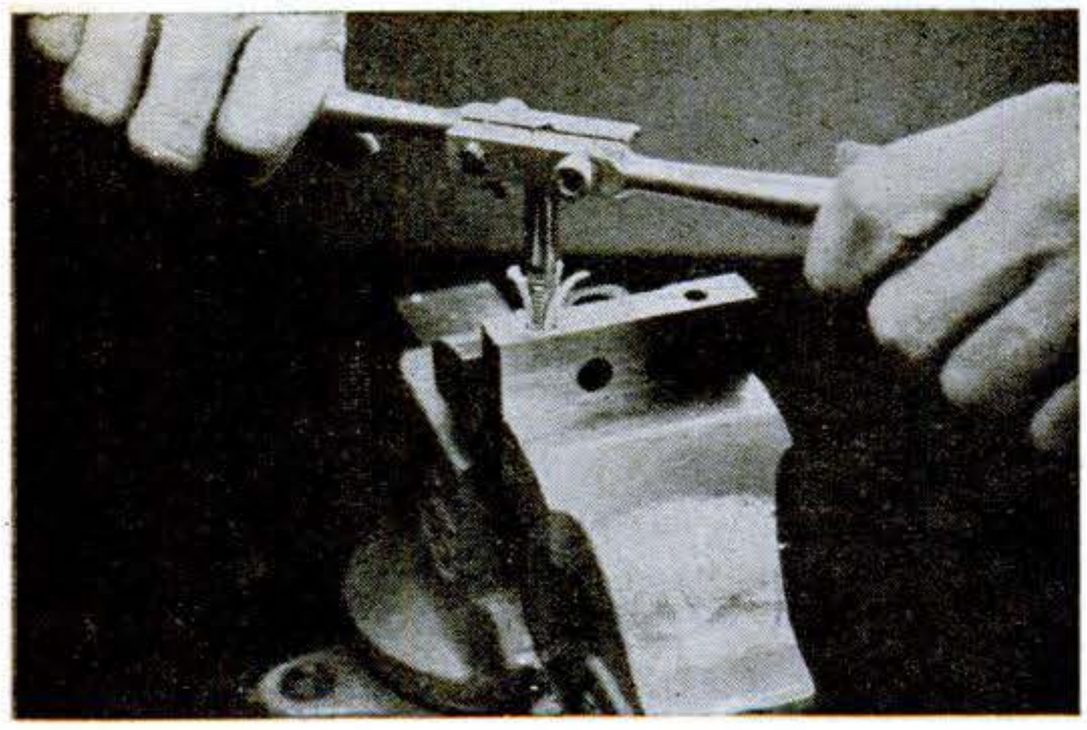
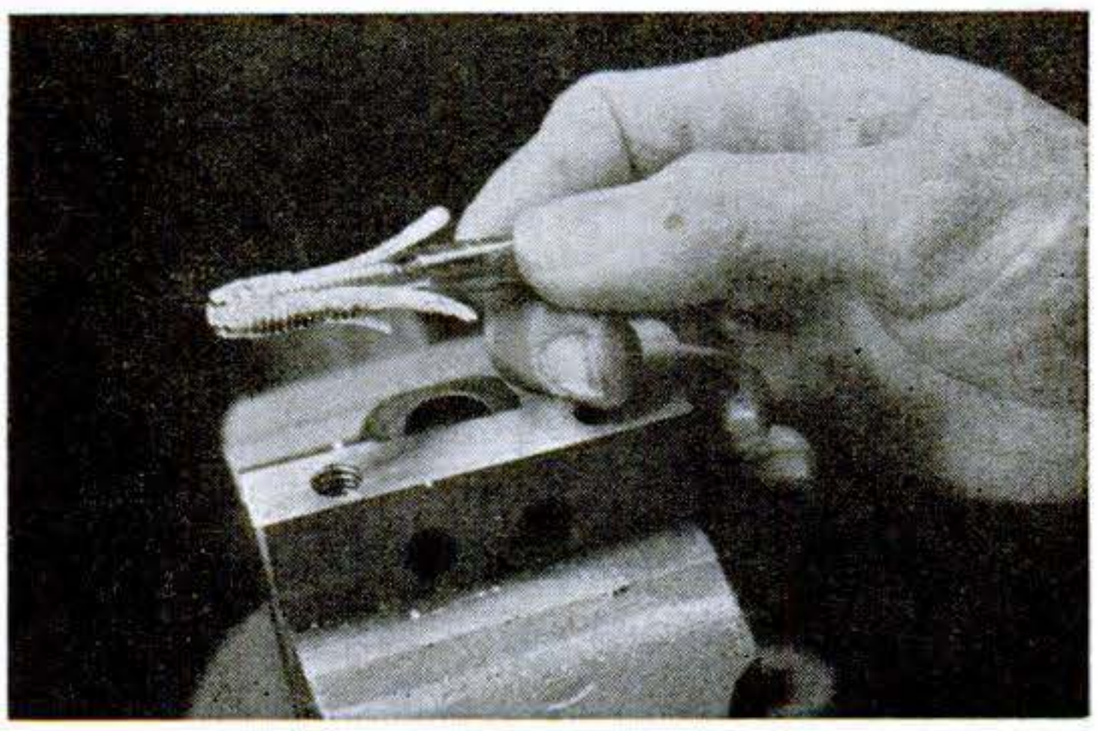
NEW SHOP IDEAS

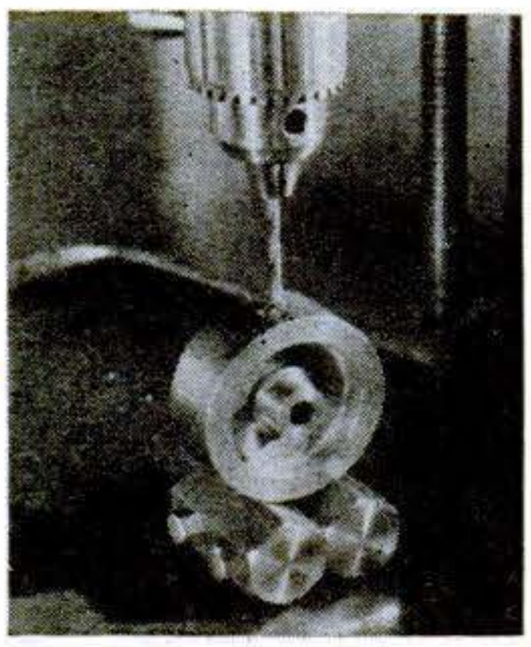


THREADING BLIND HOLES sometimes presents annoying problems. Chips that drop down past the flutes in the tap may prevent complete bottoming, increase the danger of tap breakage, and be troublesome to remove after the tap has been taken out. A simple solution is to pack the hole with ordinary soap before tapping, as in the photo at the left. When the tap is turned in, soap is forced up through the flutes, as shown in the photos below, carrying out the chips with it. If a number of holes are to be tapped, it may pay you to prepare a quantity of soap cylinders by pressing a tube through a bar of soap, removing each by pushing it through the tube with a suitable rod.—FRANK MCCARTY.

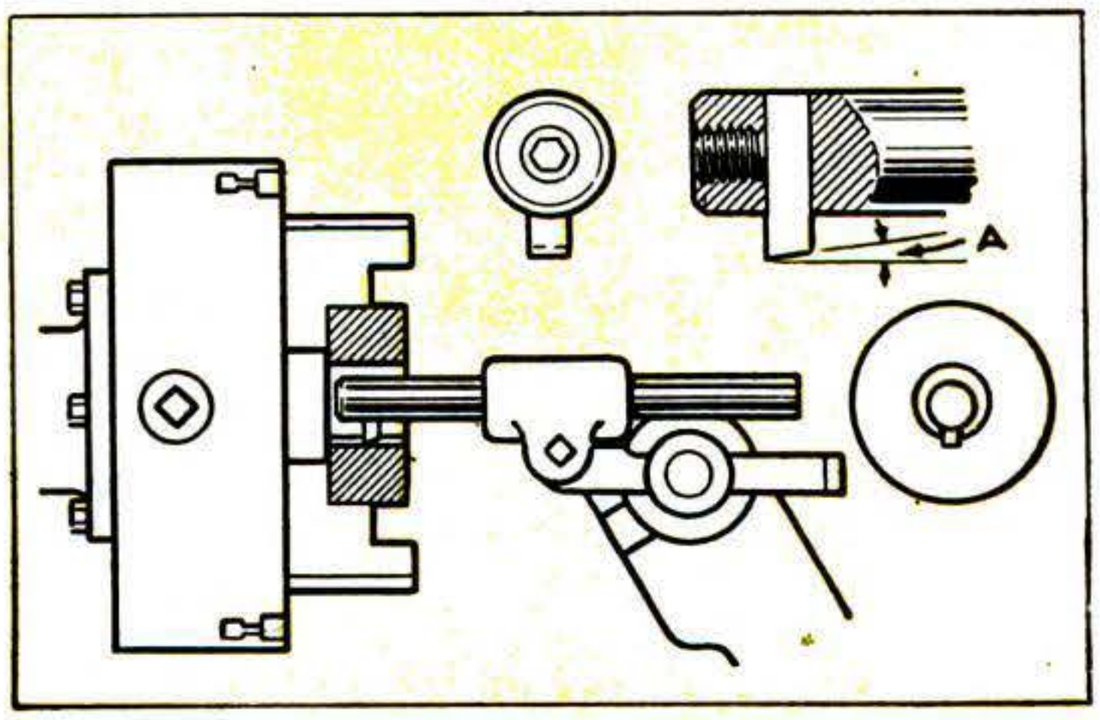




SERVICEABLE V-BLOCKS may be assembled in short order from two equal lengths of identical hexagon stock bolted together across the flats. Naturally, the larger the hex stock used, the deeper will be the V-notch formed. In drilling for the holding bolts, take pains to see that the holes are parallel and that the bars are exactly aligned.—C. W. W.



SURFACE GRINDING in the drill press with a cup wheel can be speeded up if a collar is bolted to the drill-press standard just under the table. This will permit the table to be swiveled from side to side without changing its height. Such collars are sold for clamping under the head of the drill press.—S. P.



KEYWAYS in small gears, flywheels, and pulleys may be cut in the lathe when regular keyseating equipment is not available. A square bit is ground to correct width and checked with a micrometer. Front clearance, as at *A*, should be held down to 2 to 4 deg., and the side clearances kept equally small. The bit is inserted in a standard boring bar, and is set level and at center height. The lathe spindle is locked by engagement of the back gears or the index pin, or by other means. To cut the keyway, the carriage is moved back and forward by hand with the tool fed in a few thousandths at a time on each cutting pass. For small work, braze a bit to the end of a bar.—R. M. D.

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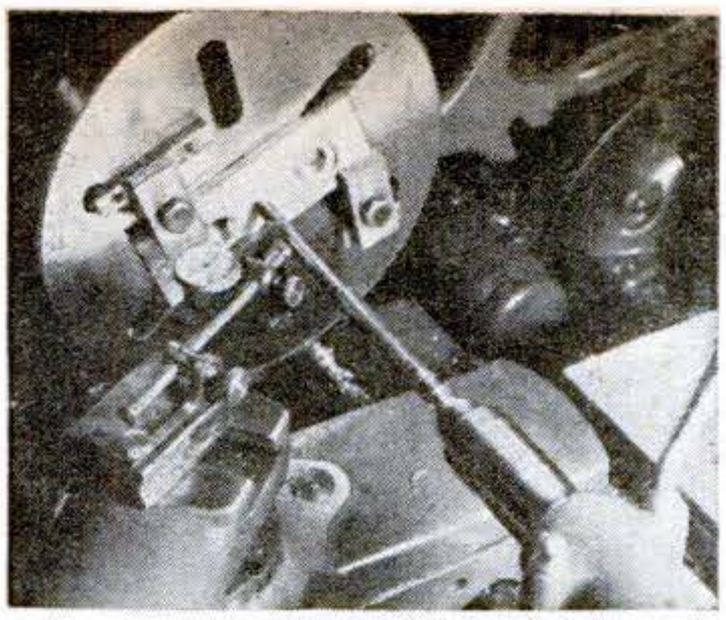
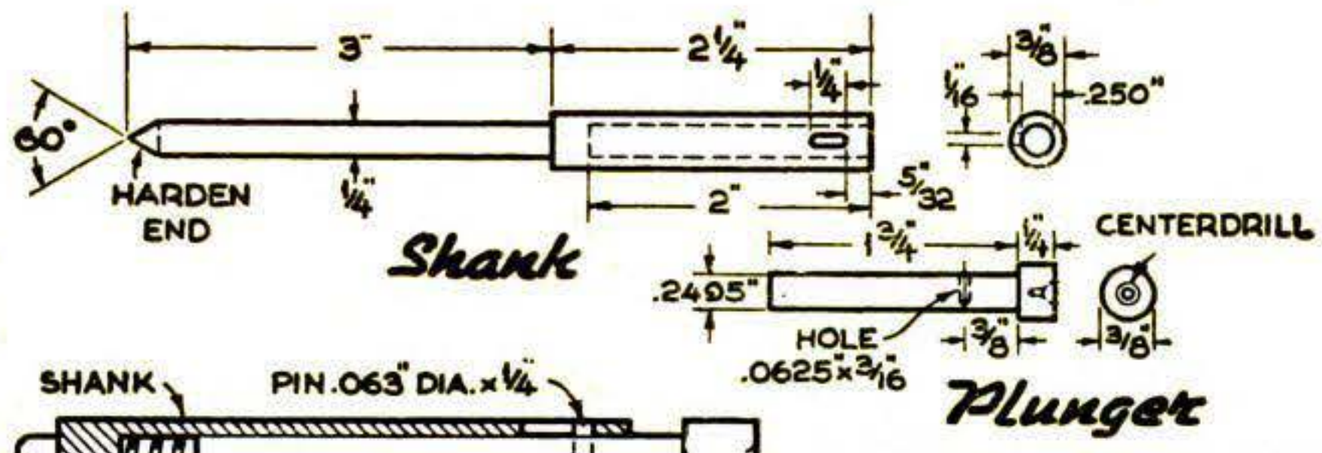
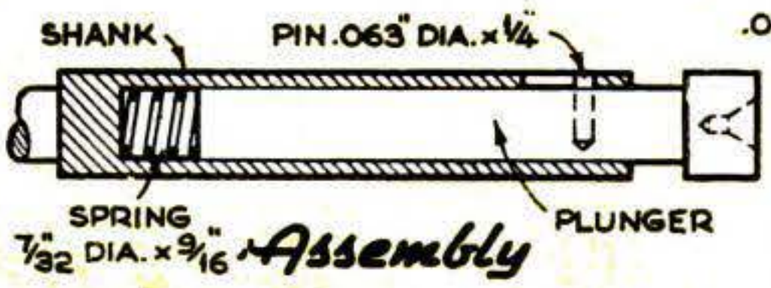
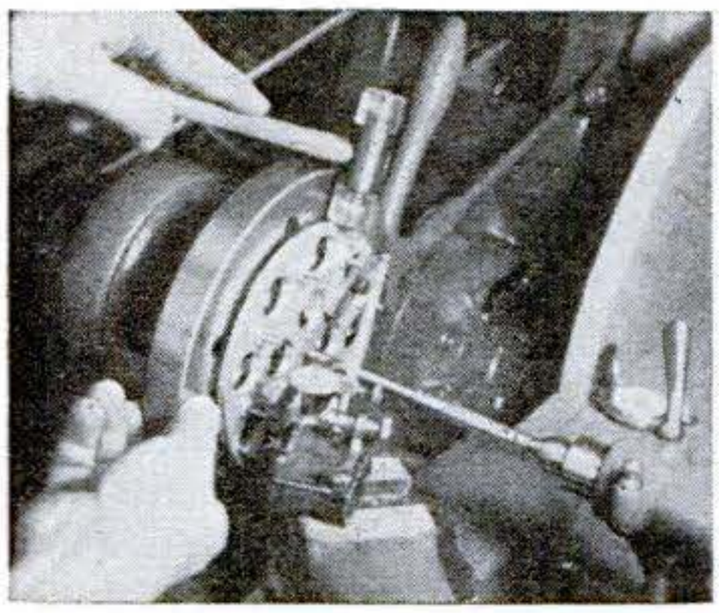


Precise centering of work may be done with the aid of this device.

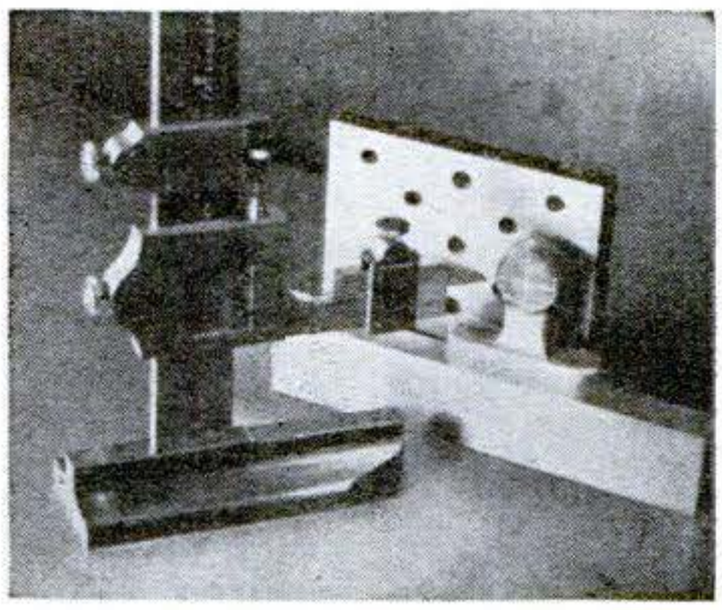




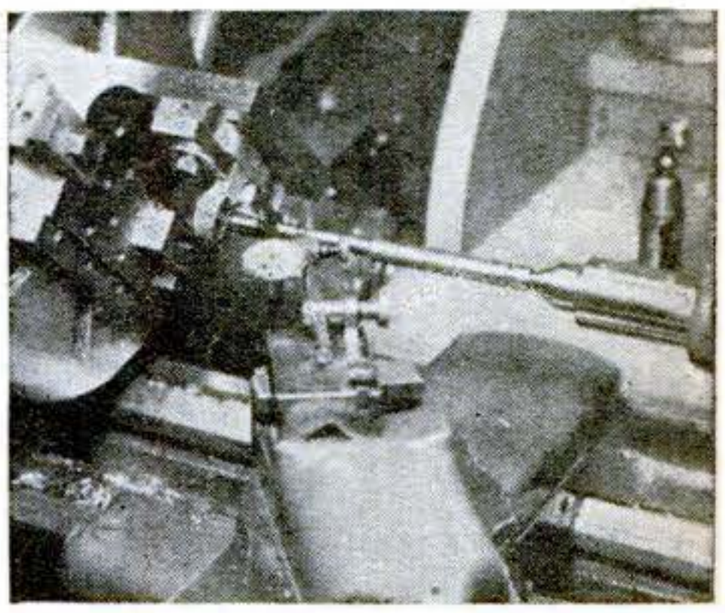
NAME	MATERIAL	QUAN.
SHANK	DRILL ROD	1
PLUNGER	" "	1
PIN	" "	1
SPRING	.020" WIRE	1



Here a pair of plates is moved to reduce the indicated runout.



Above, a height gauge is used to lay out a casting before boring.



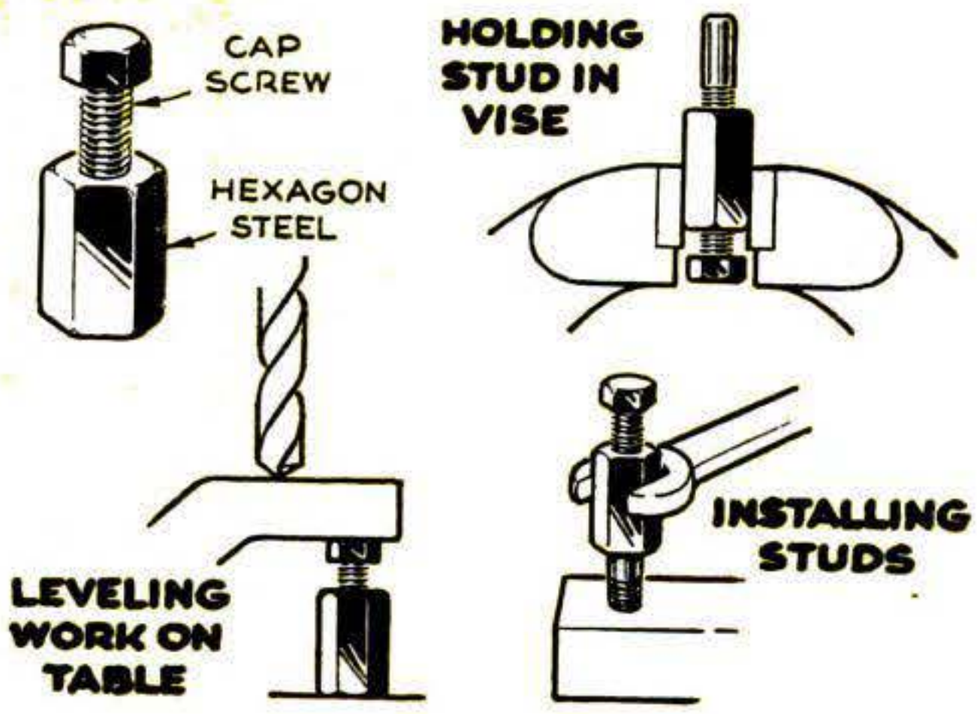
Mounted on an angle plate, this casting is now lined up exactly.

ACCURATE LOCATION of center marks for boring in the lathe, or for turning diameters concentric to a given point, cannot readily be done with the dial indicator alone. The device shown above, a simple fixture turned from drill rod, provides a surface against which the dial indicator can be brought to bear. Great accuracy is then possible, since the runout shown on the dial is twice the actual error.

Turn two pieces of drill rod to the dimensions given in the drawing, making certain that the plunger is a good sliding fit in the shank. Grind the end of the latter to a 60-deg. point and harden it; then assemble the locator with a retaining pin.

The sequence of operations in using the locator is as follows: Lay out the work carefully and lightly prickpunch the point or points to be centered, using a fine punch ground to an included angle of 60 deg. The work is then clamped lightly to the faceplate or angle plate, and the center locator is mounted under light spring tension between the punch mark and the tailstock center. After the work has been lined up by eye, a dial indicator is mounted in the toolpost with its registering point touching the locator close to the work. The runout shown on the indicator when the lathe spindle is rotated by hand is corrected by tapping the work gently until the indicator hand remains stationary during one full revolution. The work is then clamped tightly and rechecked. Be sure that the locator itself does not turn, since this might introduce errors.—J. C. M.

STUD HOLDERS, made up in a set of common thread sizes, will prove useful in almost any shop. They will come in handy for installing or removing studs without injuring the threads, for holding studs in the vise or three-jaw chuck, for occasional use as small leveling jacks, and for various other purposes. Use steel hexagon stock for the body, cut and faced to a length about three times the diameter of the cap screws to be used (this will call for a slightly larger tap drill than usual to prevent tap breakage). To screw a stud, the cap screw is first locked against the stud, and the shank is then turned with a wrench.—R. D.



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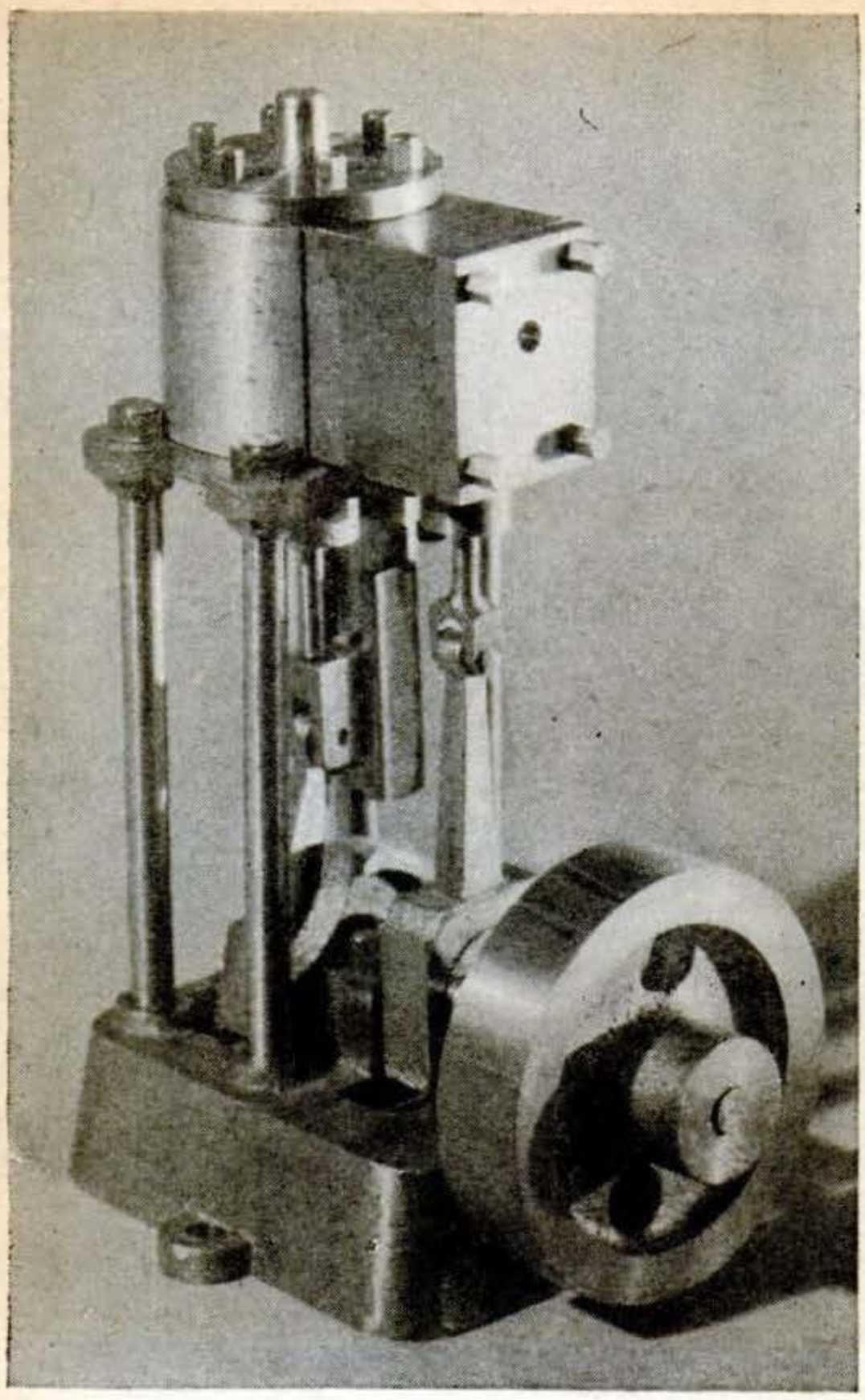


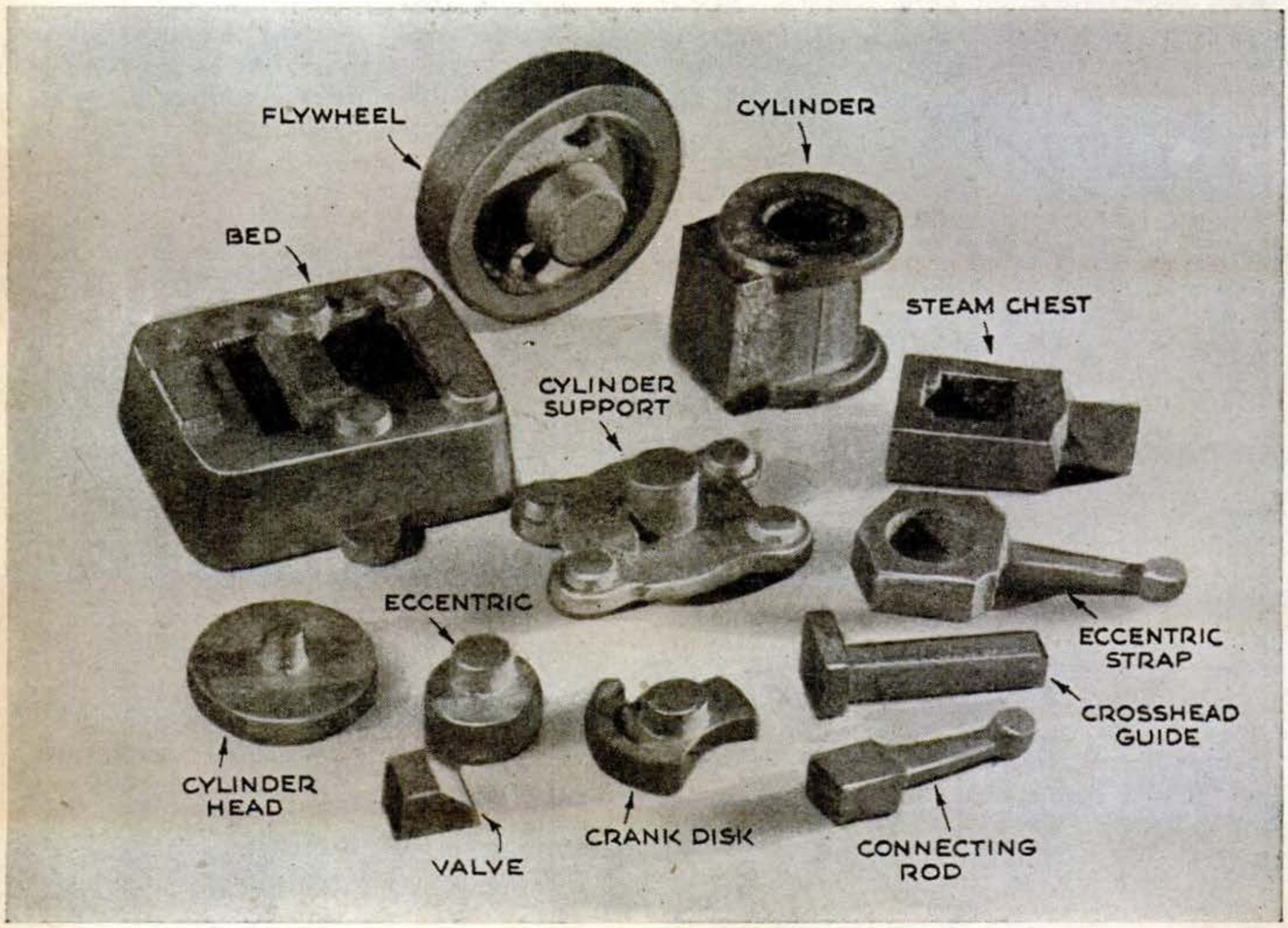
Vertical

With His Lathe and Camera, in the Construction of an

FOR the modelmaker adept at the lathe and with a flair for mechanics, small-scale steam engines are ever-fascinating projects. The craftsman handy also at woodworking can make the necessary patterns from blueprints and have the castings poured at a local foundry. Many other workers will prefer to start off with a set of castings obtained in kit form, doing the more interesting machining and assembly work.

The little vertical slide-valve engine shown at left and in color on page 116 was constructed from such a set of castings. All the castings are hard bronze, which finishes up beautifully and takes a high polish when buffed. The engine has been carefully designed for amateur construction and is within the ability of the beginner who has a fair acquaintance with his lathe. When properly machined and connected to a suitable boiler, it is a sturdy little power plant.

Model-engine kits include blueprints, but these do not show the beginner how the



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Slide-Valve Steam Engine

C. W. Woodson Takes You Through the Actual Machining Steps Efficient Little Working Model from a Set of Rough Castings

parts are to be machined to the shapes and dimensions specified. The accompanying photos illustrate actual steps in finishing a set of castings, and many of the operations shown are common to the machining of all small engines. Dimensioned drawings of this particular one appear on page 182.

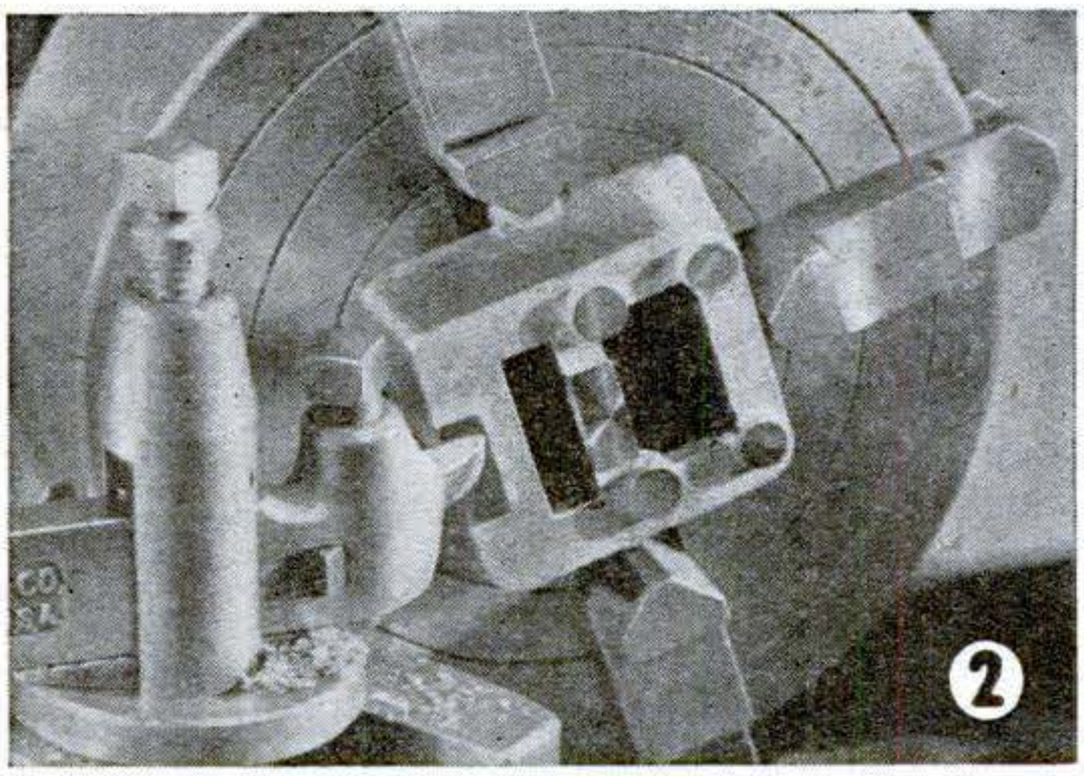
Machine work is started on the engine bed by chucking it, as in Fig. 2, and facing the tops of the bosses smooth to receive the four columns and the two main bearings. Holes can then be drilled and tapped for the columns, and the mounting lugs may be drilled for hold-down bolts.

The flywheel is faced smooth and brought to diameter while held in the three-jaw chuck as shown in Fig. 3, and the shaft hole is also drilled and reamed at this chucking to make it concentric with the rim. Reversed in the chuck, the piece is faced smooth on the opposite side. Drilling and tapping the hub for a setscrew to hold it on the shaft complete the flywheel.

Figure 4 shows the finished flywheel and bed and the two main bearings and their mounting screws. The bearings were filed smooth on the bottom, drilled slightly undersize for the crankshaft, and drilled for the clamping bolts. They were then aligned on the bed while a drill was run through them to spot the mounting holes in the bed. After they had been bolted to the bed a reamer was run through both to align the shaft holes accurately.

The four columns are a simple lathe job, merely requiring cutting to length, shouldering down, and threading on each end—the lower for screwing into the bosses and the upper for the nuts that hold the cylinder support. A gauge, made by cutting a notch 2 5/16" long in a strip of sheet metal, will help assure identical shouldered lengths.

The support is machined while held in the three-jaw chuck. Its upper surface is faced smooth. Then a step is turned (Fig. 5) to the diameter of the cylinder bore and



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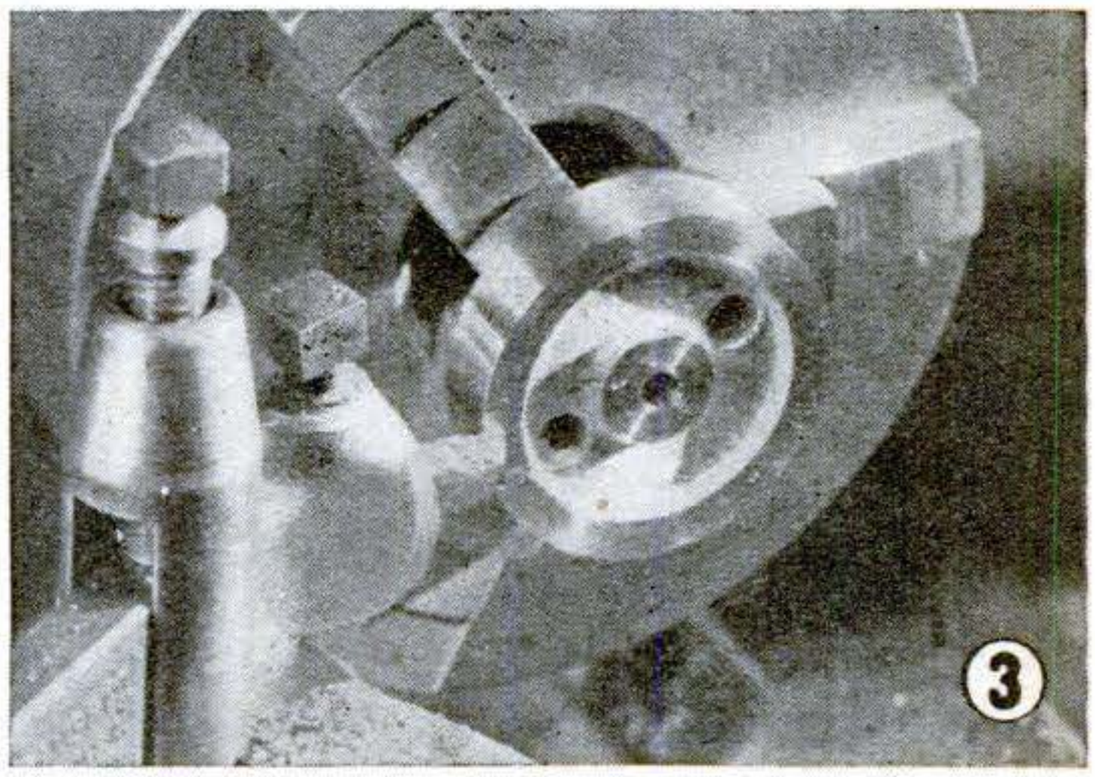

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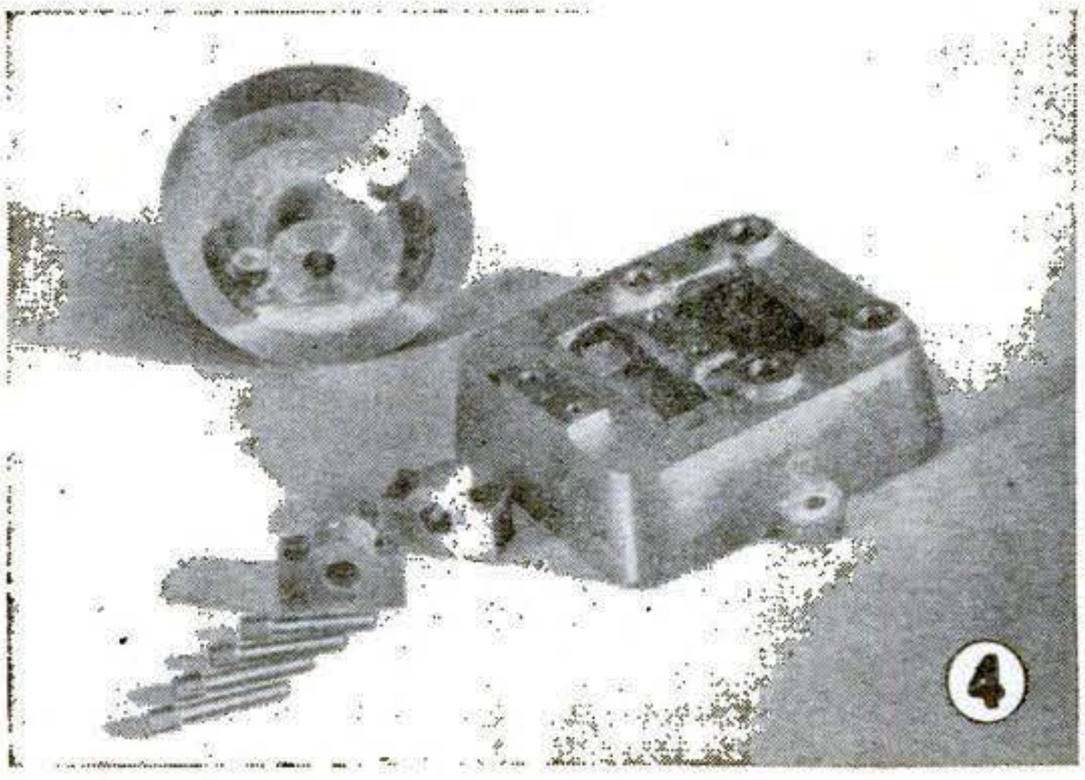

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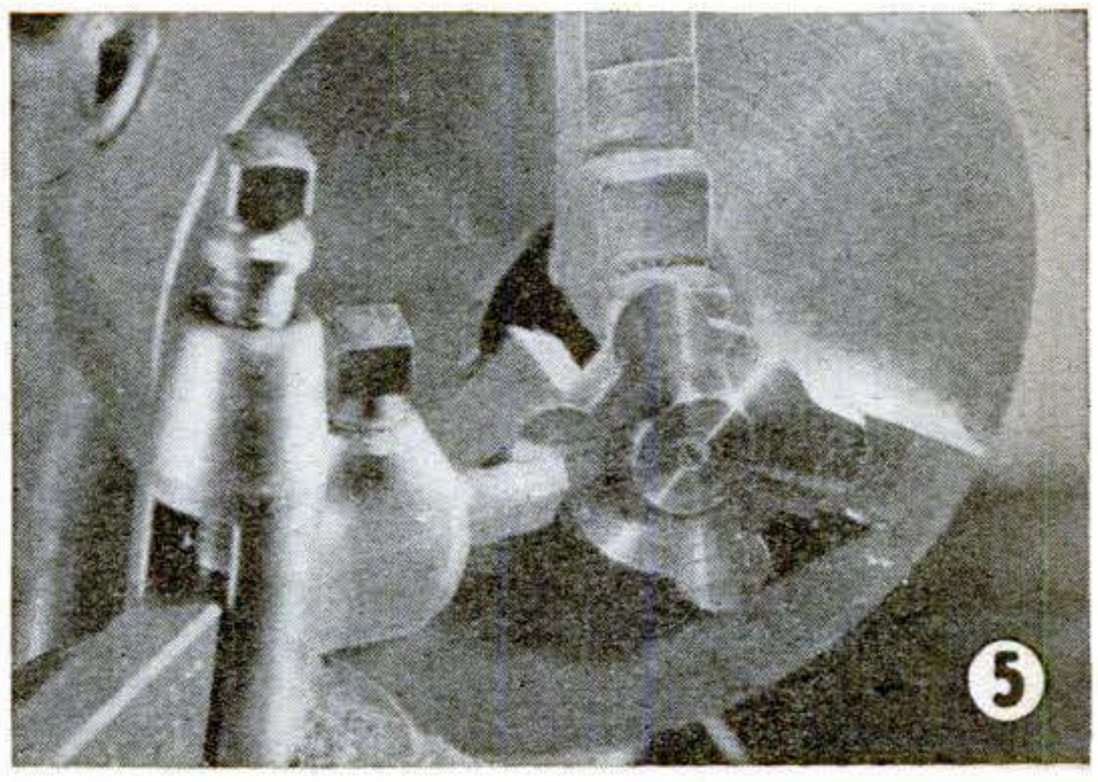

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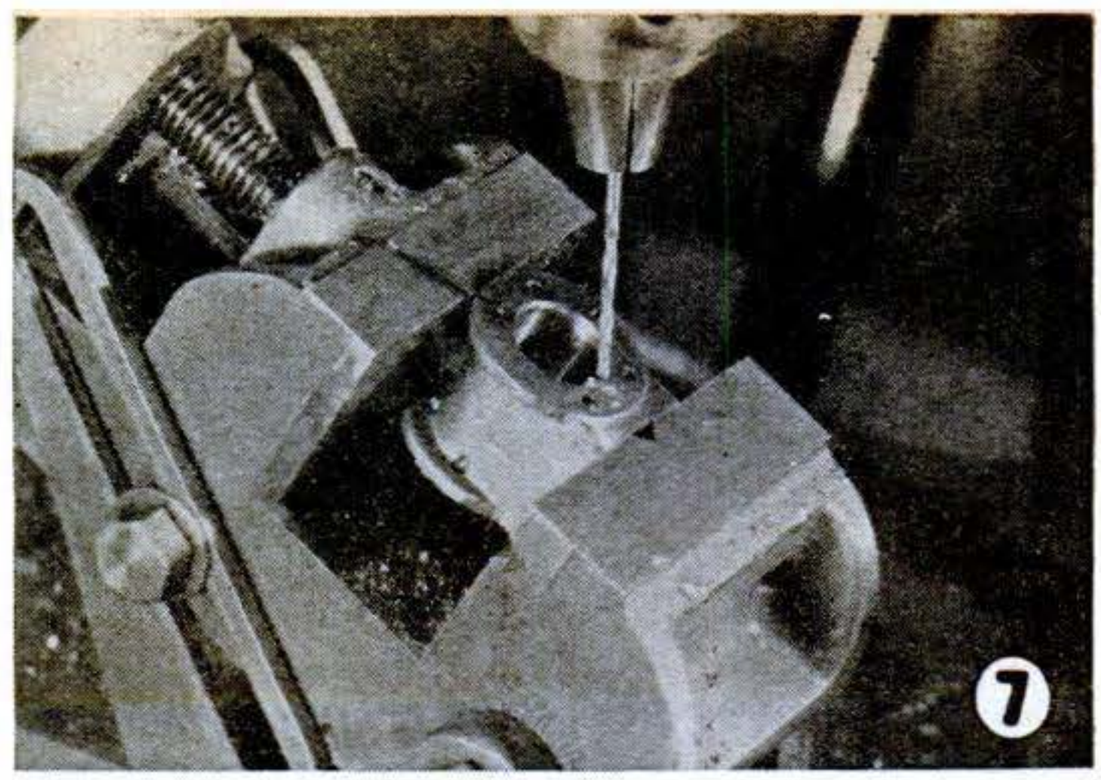

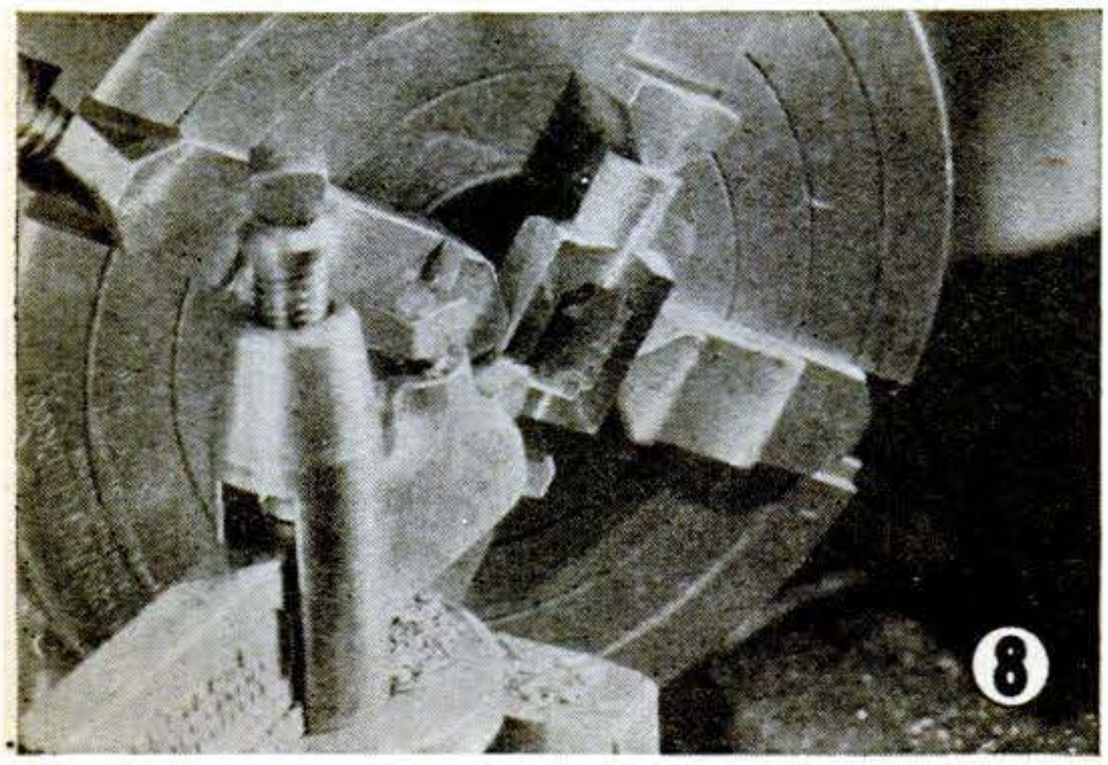

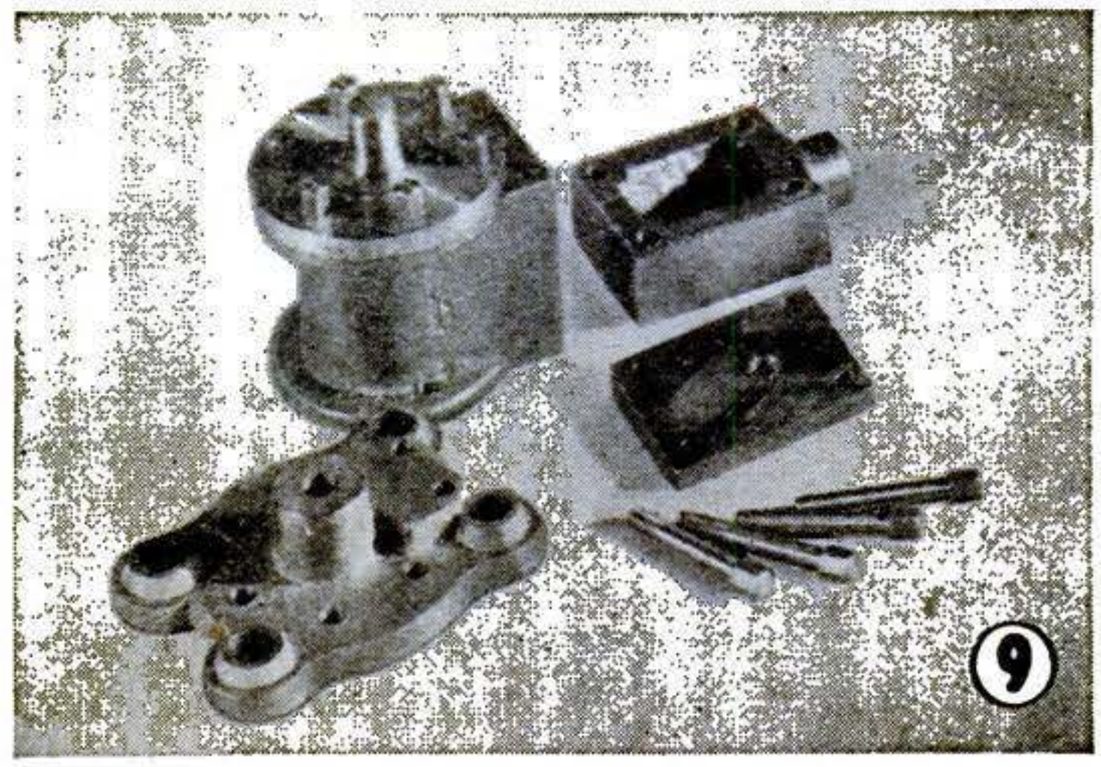

1/16" high for accurately locating the cylinder and making a steamtight joint. The piston-rod hole is drilled concentric with the step at the same chucking to assure proper centering of the piston in the bore. With the faced side flat on the drill-press table, the hole is counterbored and tapped for the packing gland. The four column holes are then drilled, and the edges of the casting are smoothed up with a fine file.

Mounted first in the four-jaw chuck, the cylinder block is accurately bored and reamed to final size, and the ends of the cylinder are faced square and smooth. The piece is rechucked with steel disks under the jaws to protect the cylinder ends, as in Fig. 6, and the steam-port face is machined smooth at high speed and with a very fine feed and a honed round-nose tool.

Steam ports and exhaust ports are carefully laid out on the ends, face, and one side of the cylinder block. Steam ports are drilled at an angle in each end, as in Fig. 7, to meet holes drilled in from the port face. To provide enough port area, two parallel holes are drilled for each, and they may be connected by chipping out the intervening metal with a small chisel. The exhaust port is drilled first from the port face and then connected with a port drilled at right angles from the side of the cylinder block.

Figure 8 shows the steam chest being faced smooth and brought to proper thickness while held in the four-jaw chuck. It is then rechucked horizontally, and the boss for the valve-rod gland is turned to size, drilled for the valve stem, counterbored for the packing gland, and threaded. The steam-chest cover is made up from ⅛" brass plate cut to size and filed to a close fit on the steam chest. Then, with the two parts clamped in position on the steam-port face of the cylinder block, four screw holes are drilled through into the cylinder block. The holes in the block are tapped and those in the steam chest and cover are drilled out to clear the screws.

Machine the top of the cylinder head first, holding it in the three-jaw chuck, and lightly scribe a circle near the edge for laying out the screw holes. Then reverse the piece, chucking the projection, face the inner side smooth, and turn a 1/32" step to fit the cylinder bore. After the screw holes have been laid out, the head is snapped on the cylinder and the holes are drilled in both parts at the same time. Repeat this operation for the lower cylinder support. Tap the holes in the cylinder and open out those in the head and support. The cylinder and its parts are shown in Fig. 9.

Chucked off center while held in the four-jaw chuck by the crankshaft boss, the eccentric is turned to shape. It is then reversed and faced, and the boss is turned to size and drilled for the crankshaft. The

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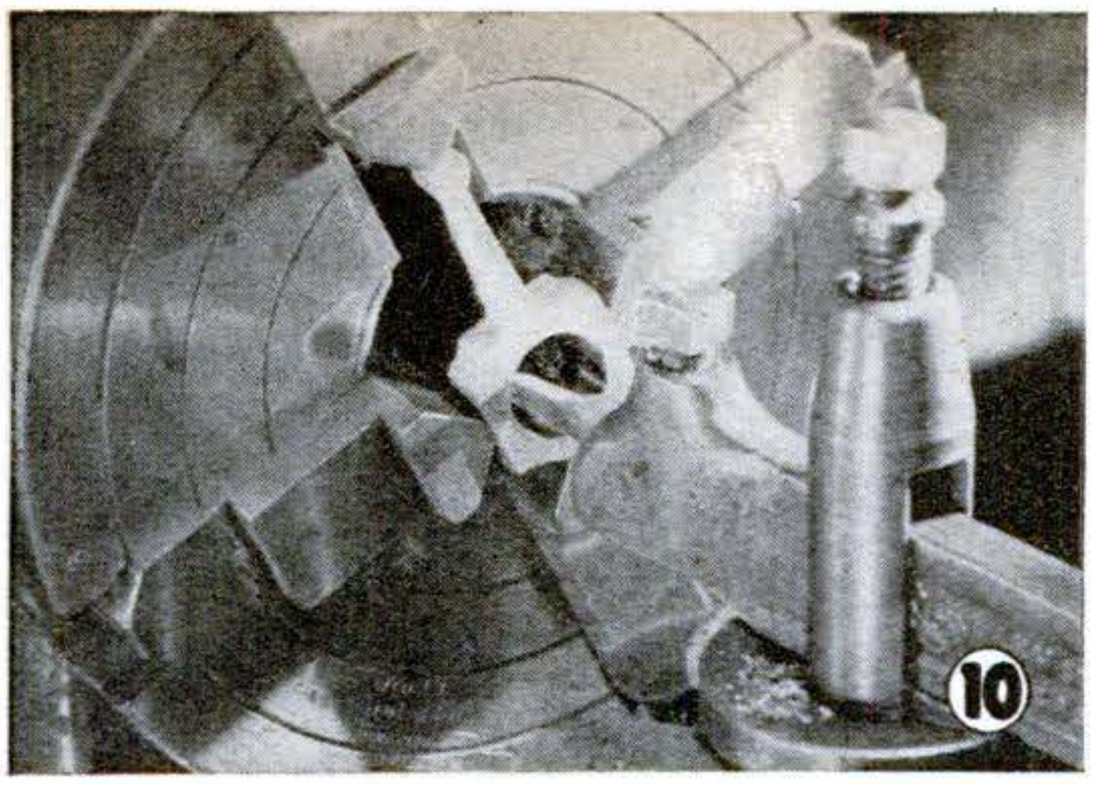

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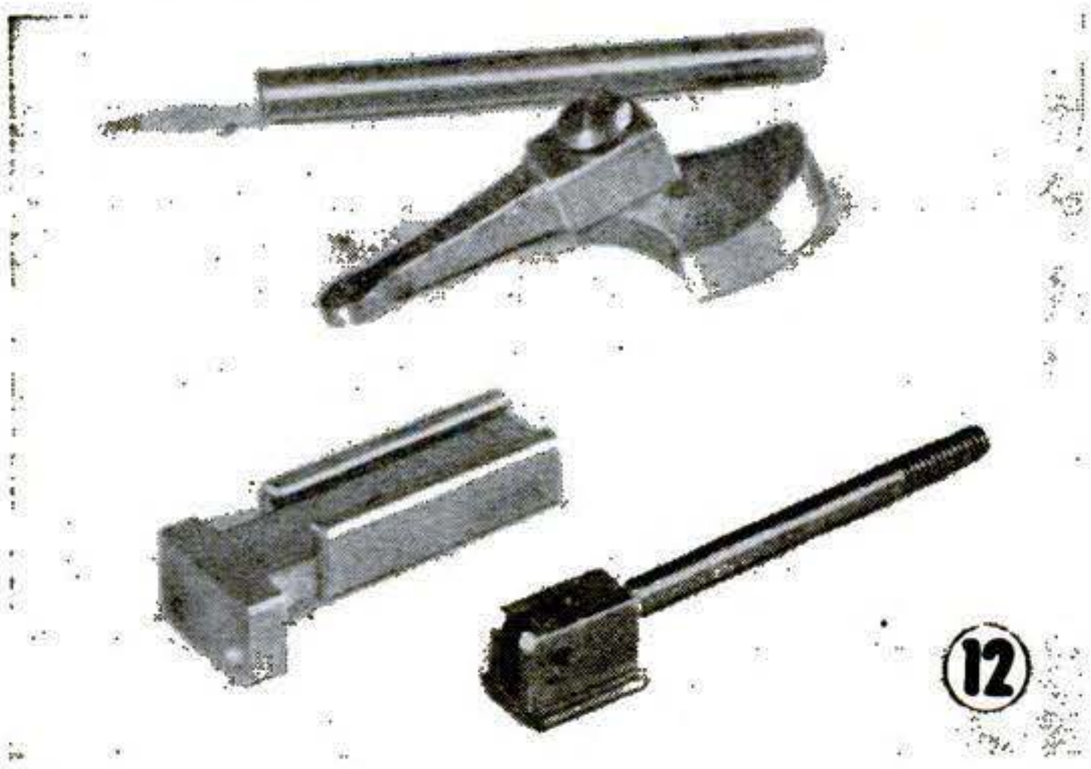

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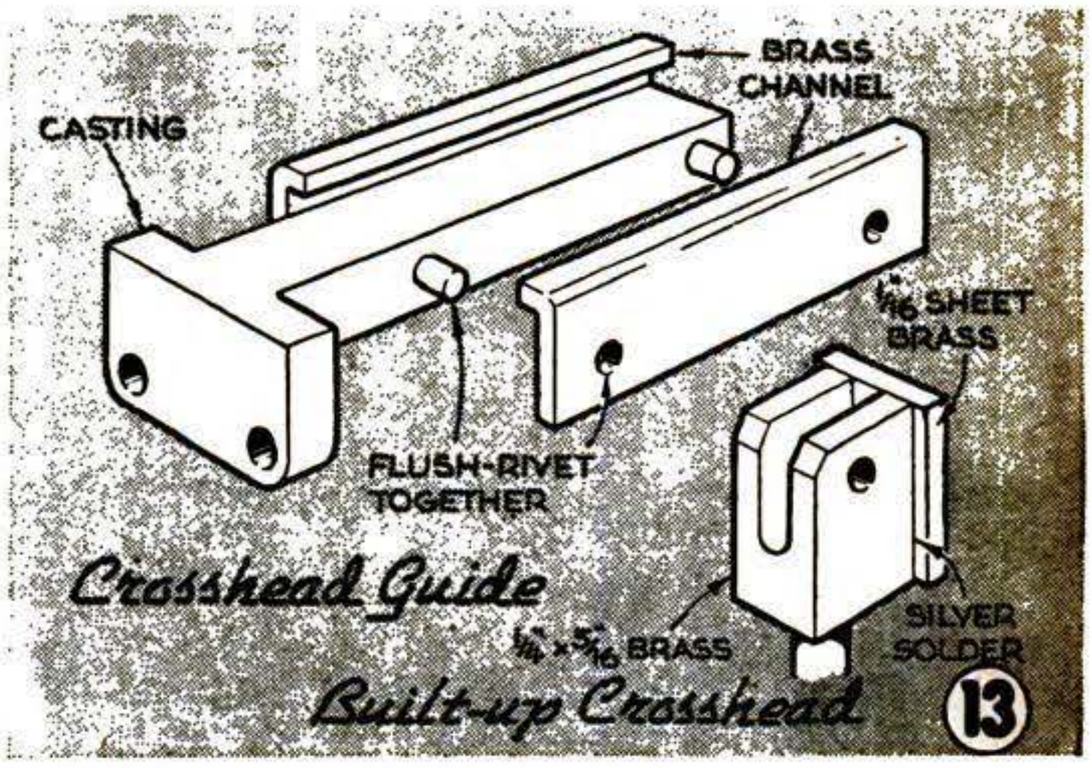

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piece is next held in the drill-press vise and the boss cross-drilled and tapped for a setscrew that holds it to the crankshaft.

In Fig. 10, the eccentric strap is held in the four-jaw chuck to be bored for the eccentric and faced smooth. Next, it is drilled and tapped for a setscrew and then drilled at the small end for the valve-rod coupling pin. The valve rod is turned from ¼" square cold-rolled steel, threaded on the turned end, slotted on the square end, and drilled also for the coupling pin. The assembly is shown in Fig. 11 along with the eccentric, slide valve, and valve nut.

Work on the valve is slightly more difficult. After machining the lower face smooth in the four-jaw chuck, work over the piece with a fine file, cutting the grooves for the valve rod and nut and bringing it to shape. Then form the cavity by drilling blind holes and chipping out with a tiny chisel made of drill rod.

The crosshead is made up from two small pieces of brass bar stock silver-soldered together. The guide is formed with a casting and two short pieces of channel brass, as shown in Fig. 12 and the drawing. Cut all the way across the main part of the crosshead, drill and tap for the piston rod, attach the shoe with silver solder, and drill for the pin. The piston rod is made from drill rod and threaded to fit the crosshead.

Machine the front of the crosshead guide smooth, file it to proper width, and face the top end smooth and absolutely square with the front face. File the channel brass to narrow one leg. Clamp the two pieces to the guide with a strip of brass under the lips to true them with the guide face; then drill the parts and flush-rivet them. Drill the two screw holes in the end and clean up with a fine file and emery cloth. Then with a fine file bring the cross head to a snug sliding fit in the crosshead-guide ways.

The connecting rod, crank disk, and crankpin (Fig. 12) are machined to size, the connecting rod being faced on its large end and drilled for the crankpin. Its small end is filed and drilled for the crosshead pin. Chuck the crank disk by the boss, face, turn to diameter, and drill a drive fit for the crankshaft. Drill and tap for the crankpin.

Turn the piston from a piece of cast iron or brass to a nice sliding fit in the cylinder bore, drill and tap it for the piston rod, and face the top and bottom smooth. The piston-rod packing gland and the valve-rod gland are turned from bar stock, threaded, and drilled and reamed for their rods.

Assemble the parts and make sure there is no sign of binding when the flywheel is turned over. Then adjust the eccentric so the valve will just begin to open the steam ports when the piston reaches either end of the stroke. Oil the parts and try the engine out under steam or air.

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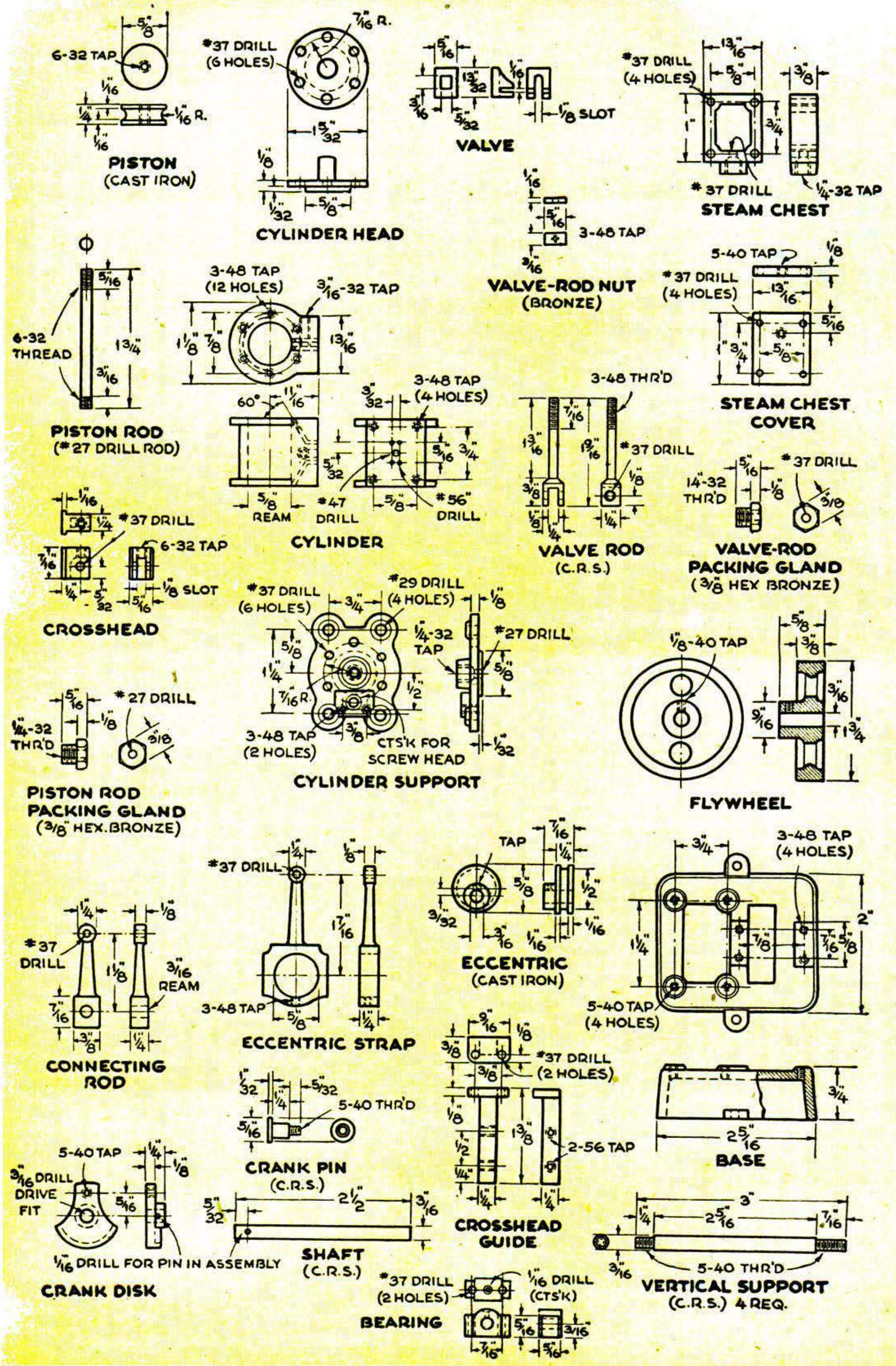

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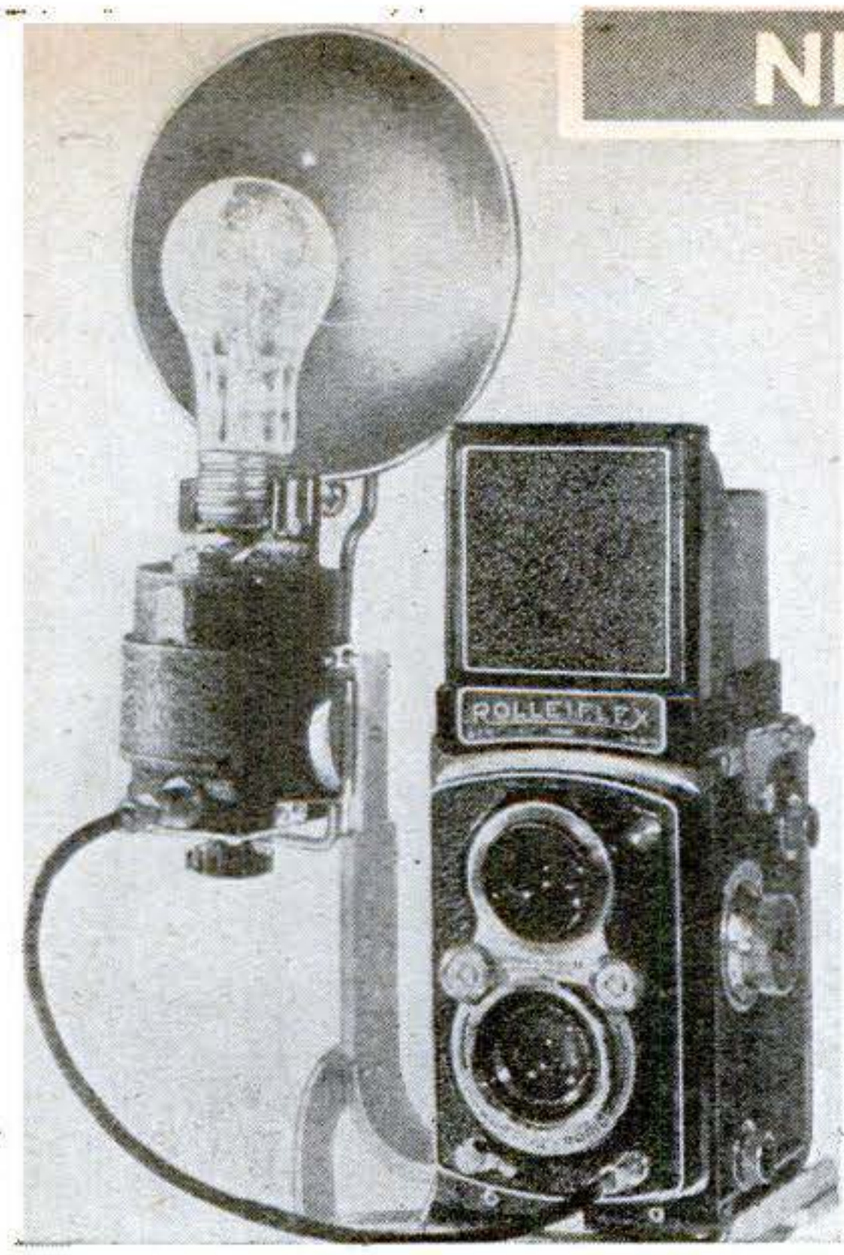
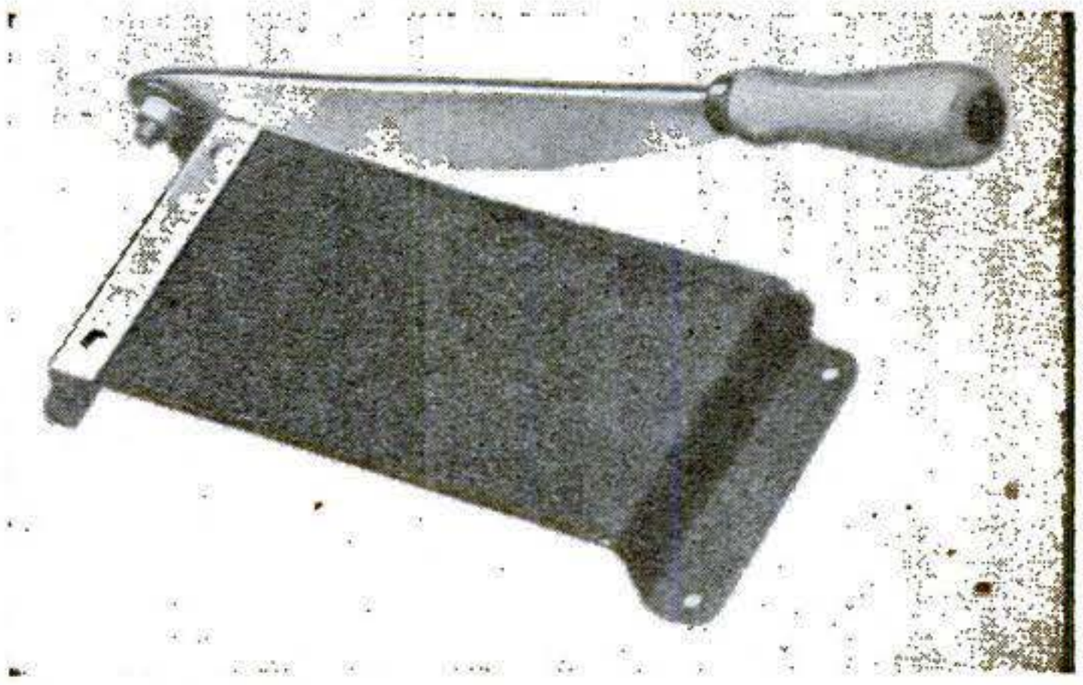
NEW PHOTO EQUIPMENT



A BUILT-IN GENERATOR driven by a spring supplies electricity for a new flash gun developed by Dynaflash Laboratories, of Los Angeles, Calif. Light in weight, the 6-volt A.C. generator has no brushes, commutator, contacts, or switches. The manufacturer says the gun was inspired by the disappointments of war photographers who often missed pictures because of weak batteries.

Firing from one to three bulbs as desired, either at the camera or up to 30′ away, the gun simultaneously trips the shutter by means of a cable release designed to prevent mechanical damage to the shutter. Suitable for any camera with a plunger-type shutter and some with focal-plane shutters, the gun can be used with various types of bulbs without adjusting the synchronization setting.

NEW DEVELOPER. Resembling an oversized match folder, a package of the Universal MQ Developer just announced by the Eastman Kodak Company contains two hermetically sealed envelopes of powdered chemicals. These yield 32 oz. of solution for tank development of film and plates or 12 oz. for tray development of films, plates, or papers. The packet is intended not only for those whose requirements are small, but also for those who want to make up fresh developer each time any is used.



PRINT TRIMMING is accomplished quickly and accurately with a low-cost trimmer supplied by the Tikern Corporation, of New York City. Measuring only 3⅛″ by 7¼″, the steel base occupies a minimum of working space. Both the blade, which has a self-sharpening edge, and the rule guide are cadmium-plated.

EXACT TIMING of any photographic operation is possible with a new universal timer produced by the Gray Laboratory and Manufacturing Company, of Dayton, Ohio. If desired, it will provide automatic timing by making or breaking the circuit of any photographic equipment that is plugged in. Second and minute hands on the 8″ dial are easily visible in semidarkness. A bell signals the time also.

TWO PERSONS MAY VIEW color slides or strip film simultaneously with a desk-type viewer manufactured by the Adel Precision Products Corp., of Burbank, Calif. A 2″ by 2″ slide of any type is accommodated, compensation being made automatically for the thickness. The viewer, which is 5″ by 7″ by 7″, operates either on a self-contained battery or on house electric lines.

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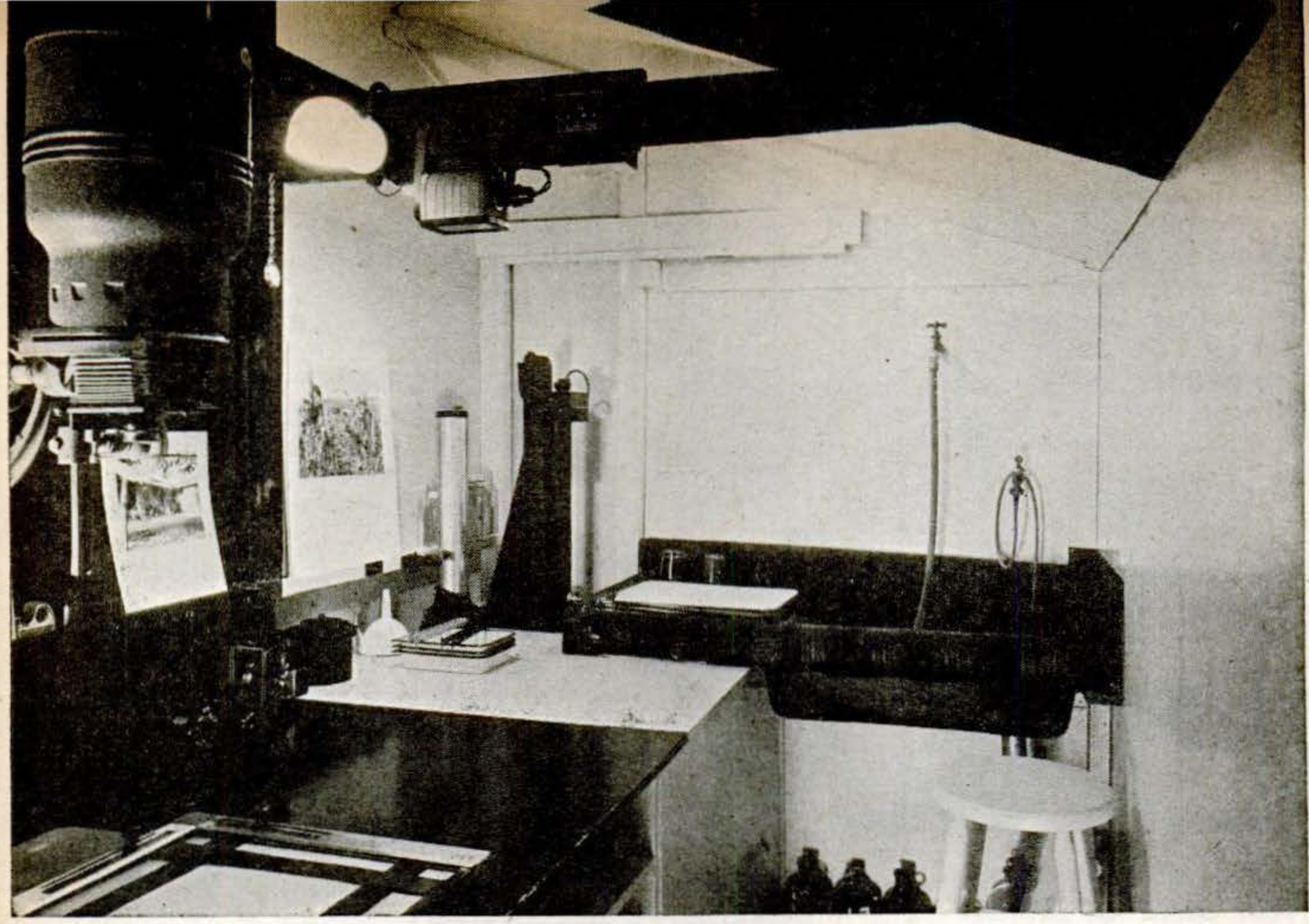


HANGING DARKROOM

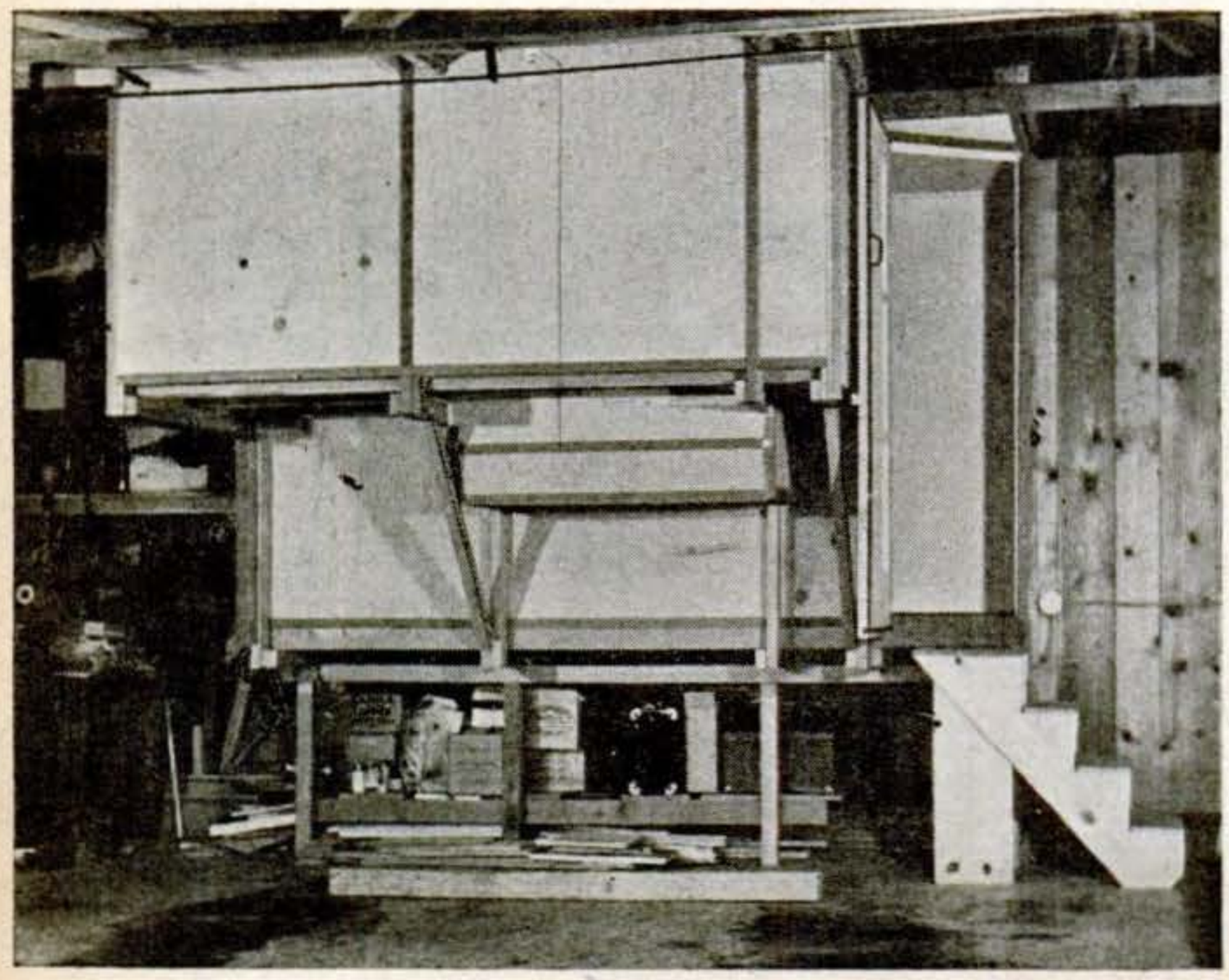
Utilizes Waste Garage Space

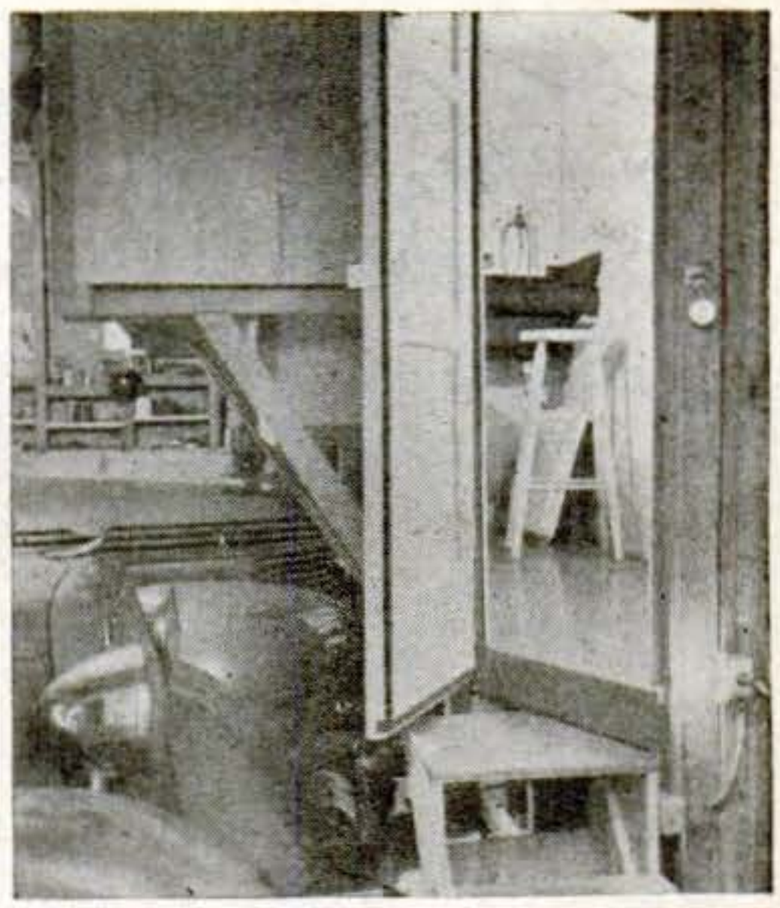
By RICHARD B. LEWIS

IF YOU think that floor space is lacking in your present quarters for a permanent darkroom, perhaps you can profit by my experience. I managed to materialize my darkroom out of thin air—by hanging it in the back of a two-car garage.

In the typical double garage, there is space for a darkroom more than 10′ long and almost 6′ deep, provided that it is built with its floor over the space normally occupied by car bumpers, and with its workbench overhanging the car hoods. A bump bar attached to the garage floor stops entering cars just short of the structure.

The room pictured did not involve difficult carpentry, and required but 14 working days





Two views of the finished darkroom. Besides serving as a reminder that the master switch is on, the pilot lamp also helps light up the steps.

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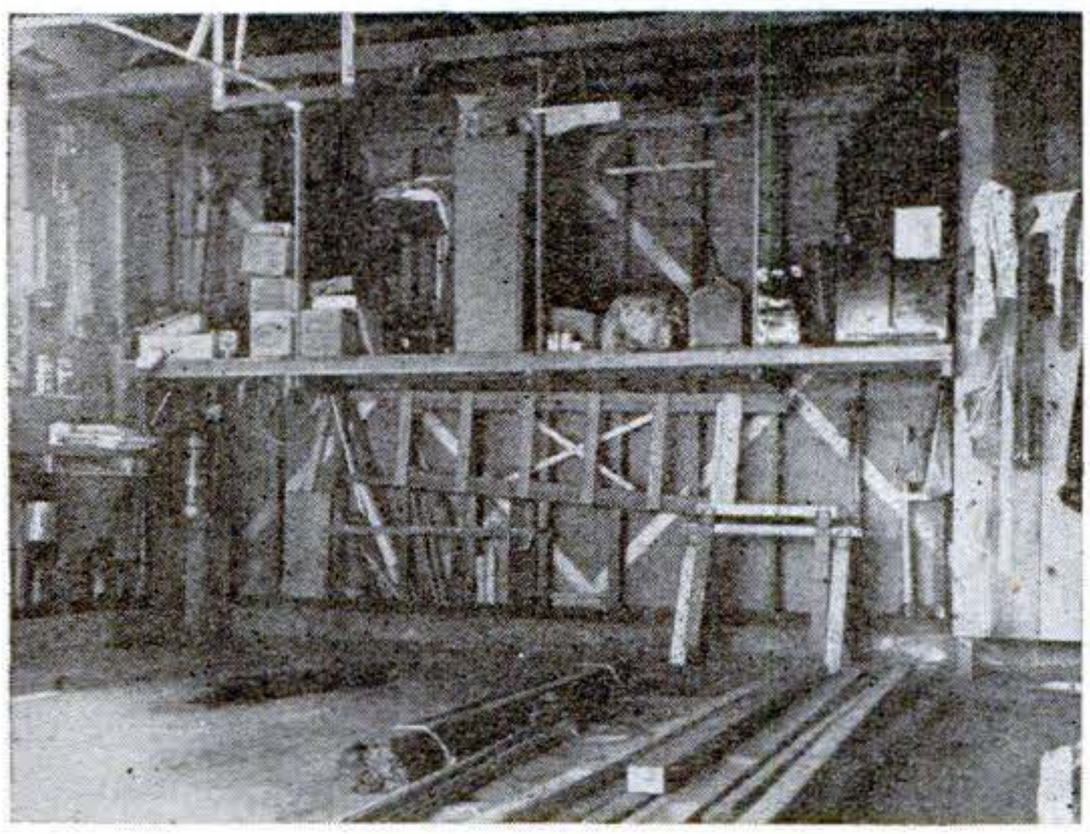
for one man to build. The first step was to make sure that part of the weight of the structure could safely be hung from the garage rafters, with the remaining weight transmitted to the floor through posts and braces. The actual installation of the studding, floor and bench took two days; wall paneling, ceiling, and trim took five days more; and seven days went into plumbing, wiring, and painting. Materials and all wiring and plumbing fixtures cost $83.12 at 1941 prices.

While the dimensions of any such darkroom will naturally have to be tailored to the garage and to the cars that use it, those of the room shown may be useful to persons undertaking a similar project. The overall inside length is 10′ 3″; length of the bench, 8′ 6″; depth of bench, 3′ 1″; sink, 20″ by 30″; clear width of floor space, 30″; floor to ceiling at the back wall, 6′; bench to ceiling at the front wall, 6′; and the bench height, 34″. The bench top is 6′ above the floor of the garage, and the floor of the darkroom is 38″ above the garage floor.

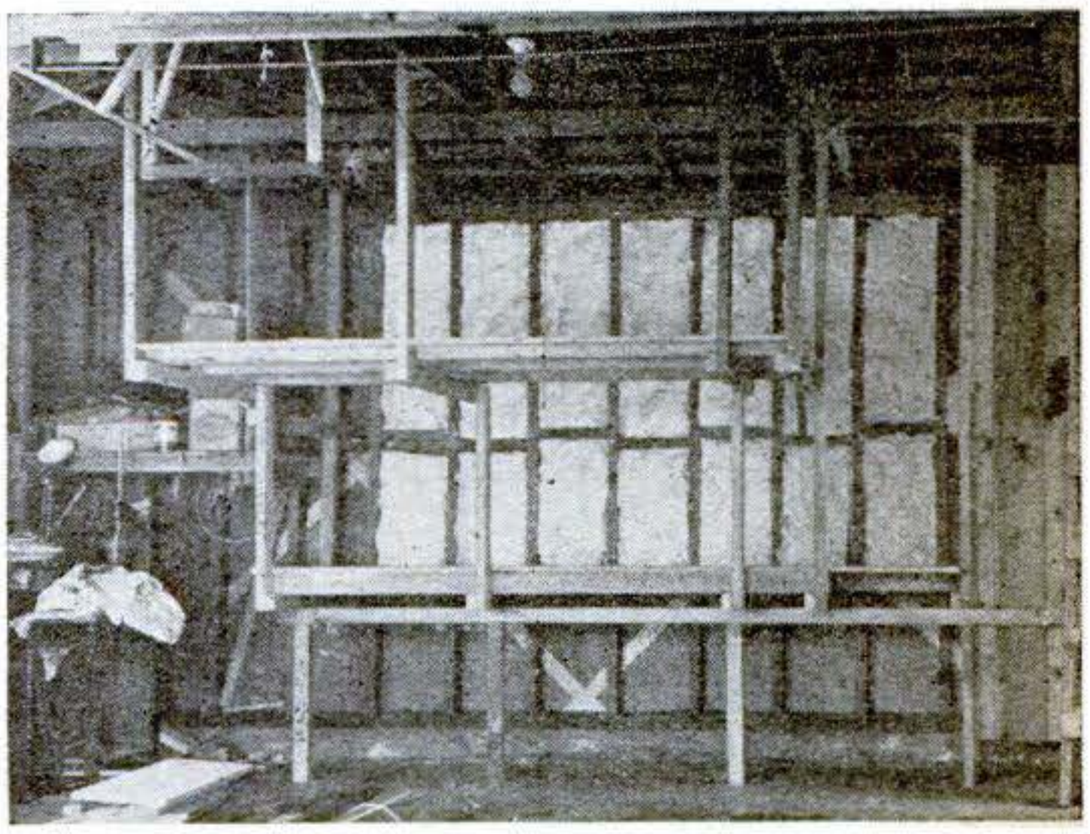
Well-planned wiring and plumbing are of course essential features in a good darkroom. Nine electric switches are centralized in three switchboxes on the beam above the workbench. From any point in the room, even in the dark, any switch can be conveniently reached and identified. A fused master switch and pilot light are located outside the door, where the pilot light reduces the chance that a light, drier, fan, or heater may be left on accidentally. Electrical outlets are installed in patented conduit along the back of the bench, on the beams, and on the walls.

The sink drain has two separate outlet pipes controlled by a selector valve; a turn of the valve in one direction sends waste chemicals into the sewer, and a turn in the other direction sends wash water from prints or films into a hose that leads to the flower beds and lawn outside.

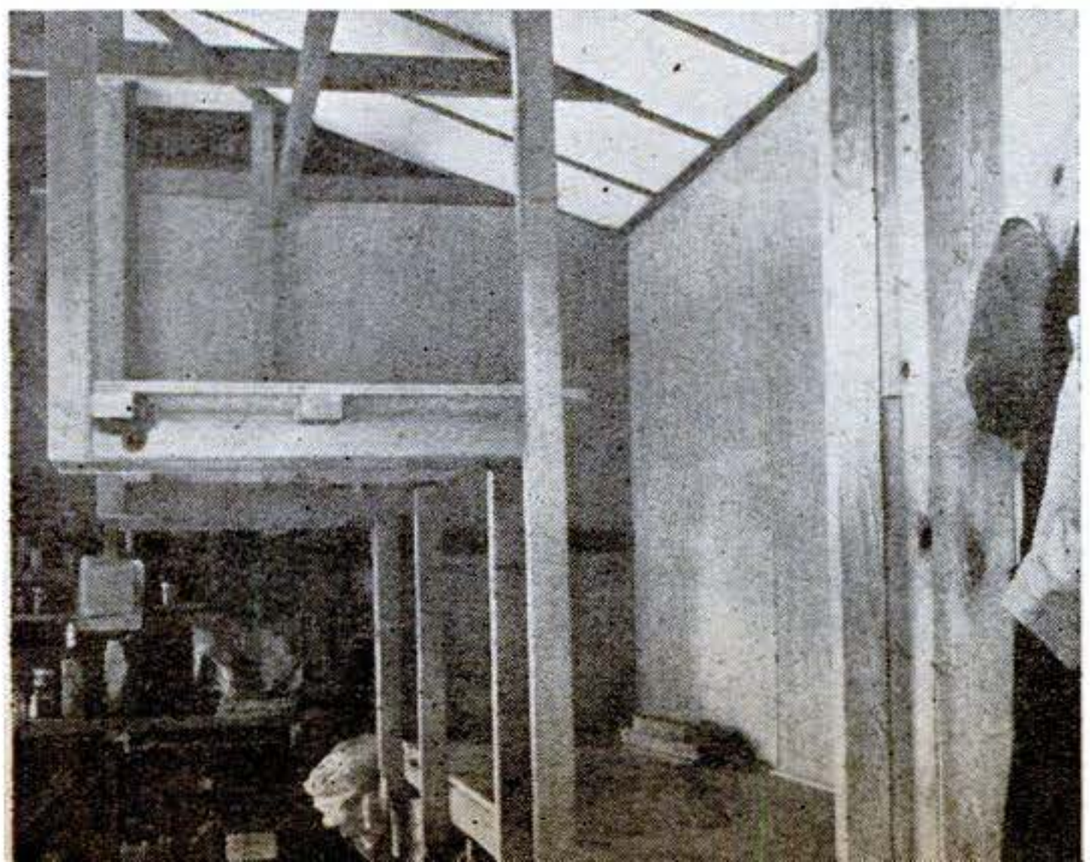
Since the back wall of the darkroom is insulated with rock wool, a small electric heater is sufficient to maintain a comfortable temperature in winter. An exhaust fan situated in a light trap provides ample fresh air. Joints in the walls are sealed with calking compound, and the door, when closed, is sealed with sponge-rubber tape. Interior walls are finished in light green enamel, except the walls and ceiling near the enlarger, which are flat black to cut down stray-light reflection.



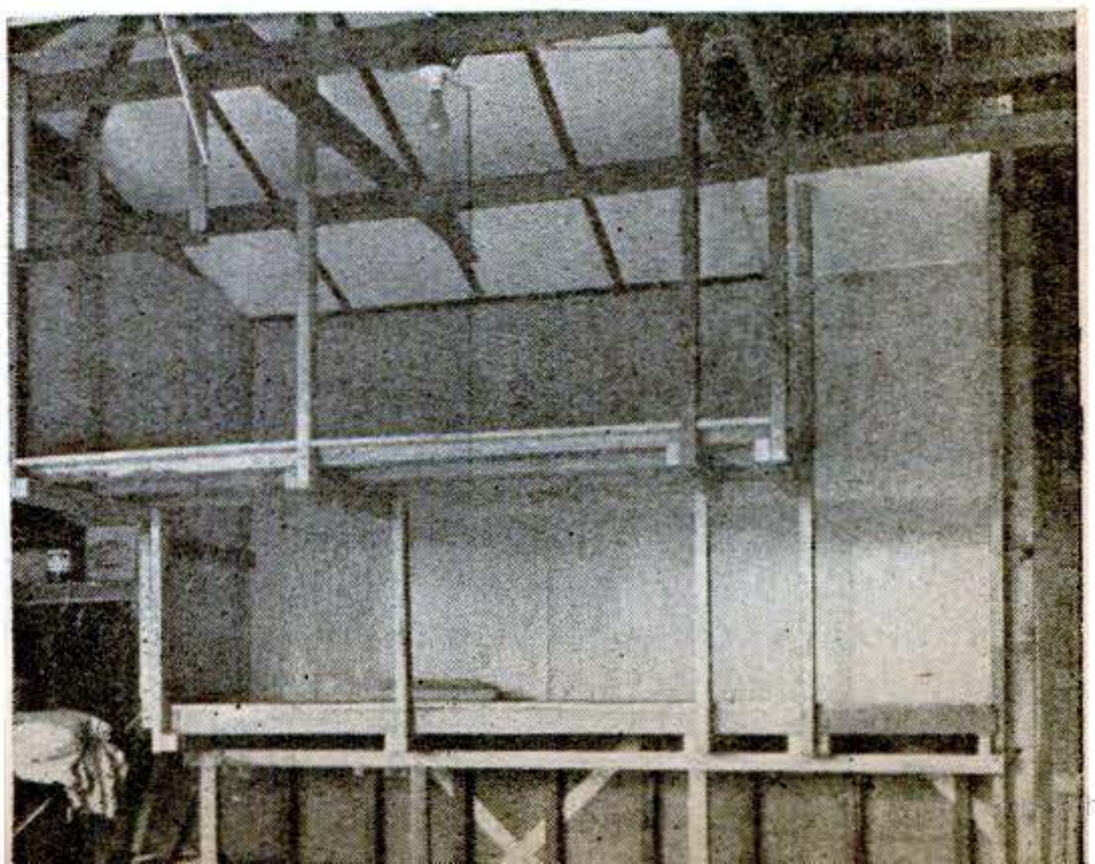
Above, the garage wall before construction of the darkroom. The space was used for random storage.



After two days' work, studding, floor, bench, and insulation were in place. Note the simple framing.

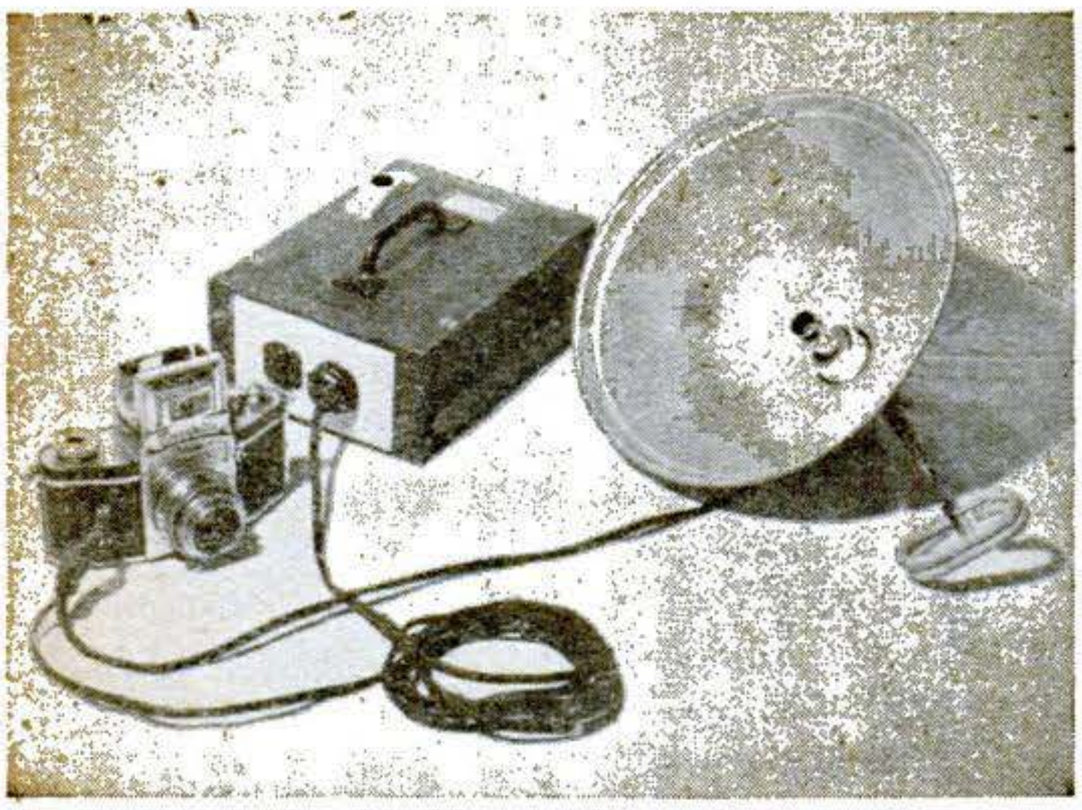


Back panels, side wall, and ceiling were installed next. Plywood was used for the flooring and bench.



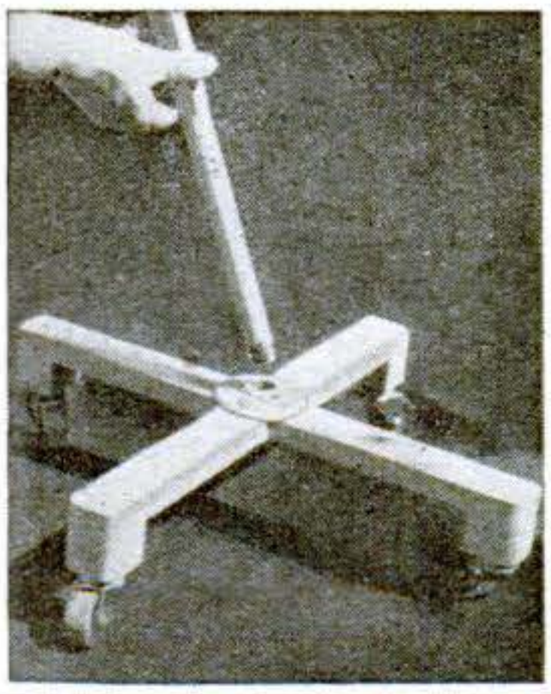
Weight of the darkroom is divided between the roof and floor. A stop keeps autos in their place.

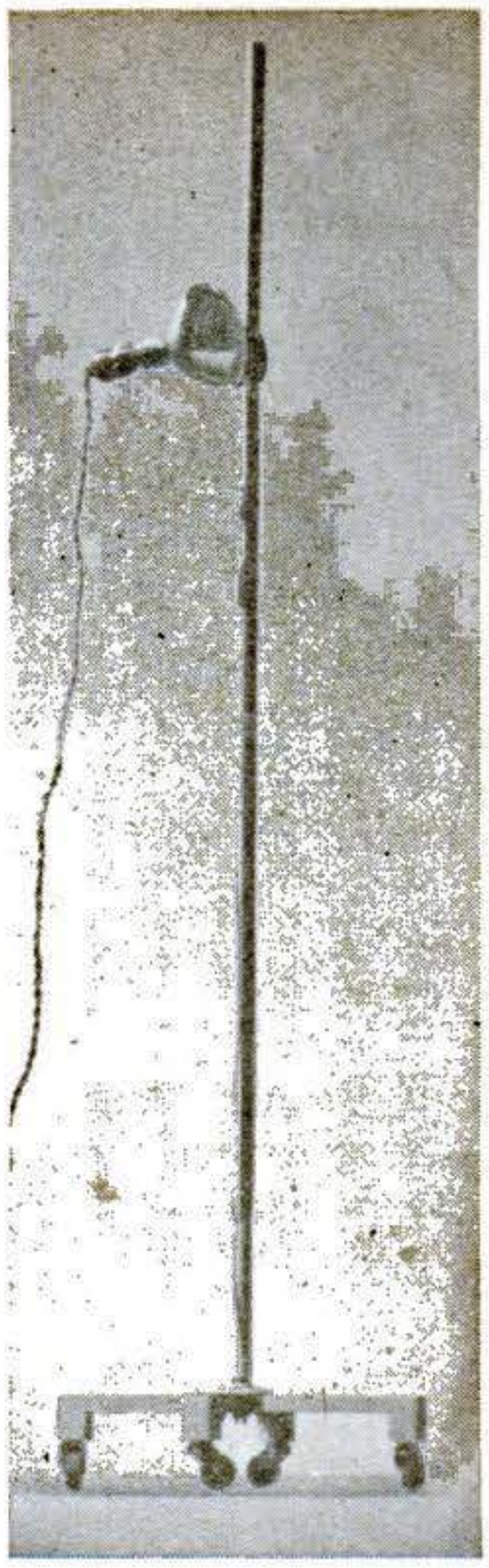
PHOTO IDEAS



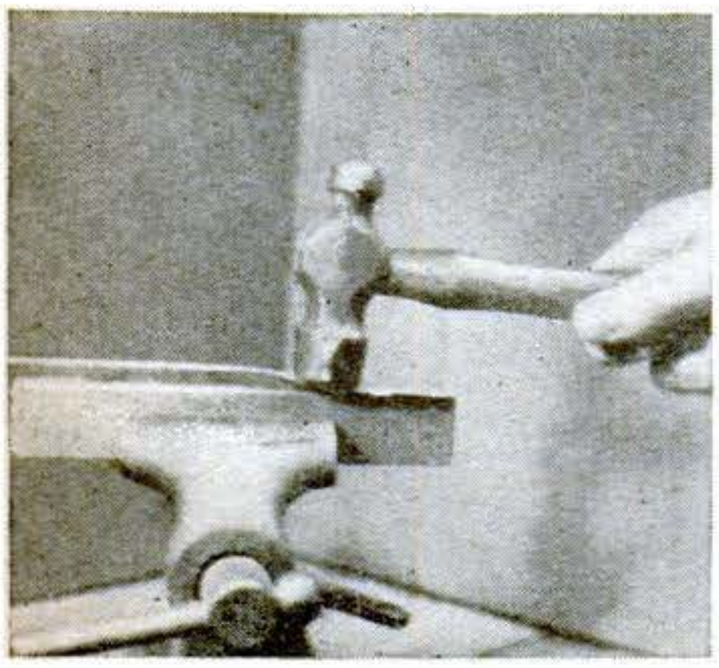
DEPENDABILITY is a major feature of the flash-bulb battery box above. Built of scrap wood, it contains two No. 6 dry cells, furnishing 3 volts in series, which are wired to double outlets at both ends of the box. The same cells have given good service for nearly a year, and, on occasion, have been used with more than 40′ of wire and two reflectors. One power outlet is wired through a push-button for use in taking pictures by open flash. The other supplies current for use with a synchronizer. A sash lift serves as a carrying handle.—ROBERT K. GRAUL.

LIGHT STAND. Designed for a reflector bulb in a clamp-type socket, this stand will be handy in a studio. The column is a 72″ length of ¾″ by ¾″ hardwood rounded at one end to fit snugly into a 12″ piece of ½″ pipe which screws into a floor flange on the base. Two pieces of stock ¾″ by 1¾″ by 18″ were glued together with a half-lap joint for the base, and blocks were added to take casters.—S. POTT.





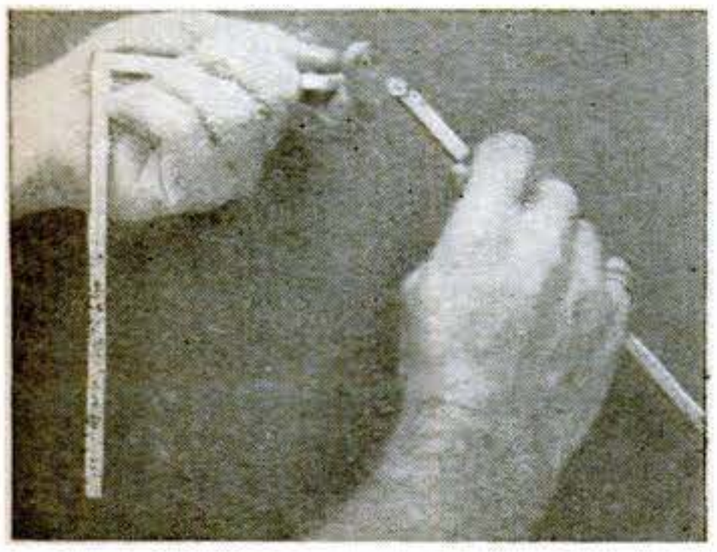
Mounted on casters, the stand is easy to move.



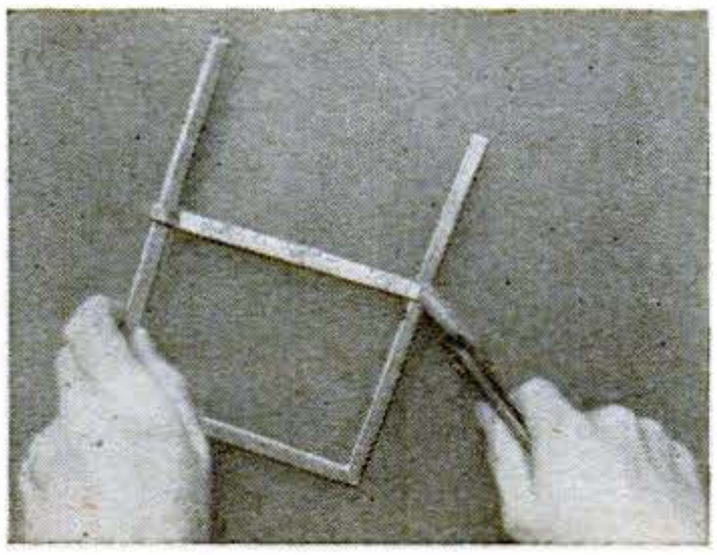
1 Hammer linoleum binding over a steel strip to form a channel.

FILM HANGERS may be made at home at little cost. For the 4″ by 5″ size, bend a 24″ length of ⅝″ stainless-steel linoleum binding over a steel strip ⅛″ thick (Fig. 1) to form a channel. Then cut the channel into two pieces, one 18″ long and the other 6″. Saw down to the bottom of the channel 6½″ from each end of the 18″ piece and bend it inward (Fig. 2). Next, remove a ¾″ piece from one side of the channel at each end of the 6″ strip and gently bend the remaining tabs to a sliding fit around the frame (Fig. 3). For the bar at the top, cut a strip ⅜″ by 9½″ from 1/16″ stainless steel and grind grooves in its upper edge to fit tabs 1″ long formed at each end of the U-shaped frame. Bend these around the bar (Fig. 4) and hammer tightly in place. Grind two ½″ slots in the bottom of the frame for drainage.—ED SHOLANDER.

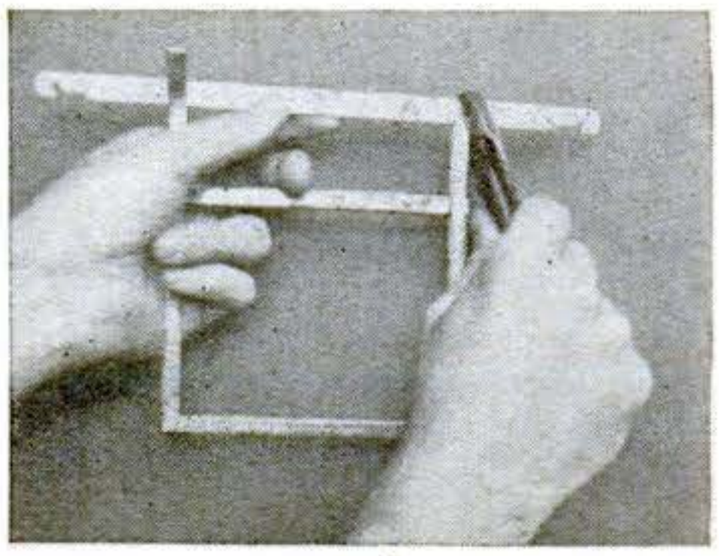
2 Cut the sides of the channel in two places, and bend it inward.



3 Now attach the top so that it slides on the U-shaped frame.



4 Clamp the frame to a cross-bar and the hanger is ready.



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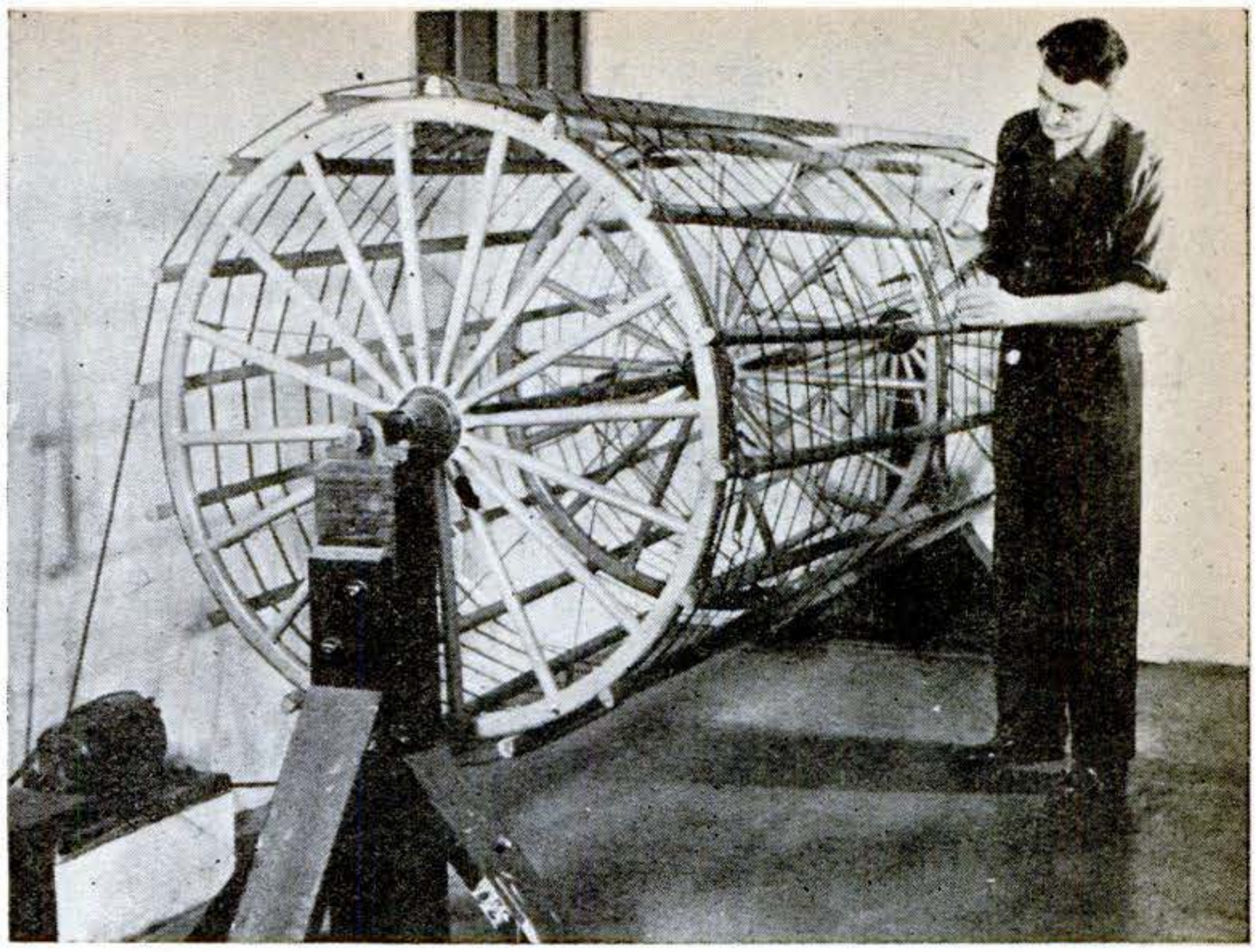
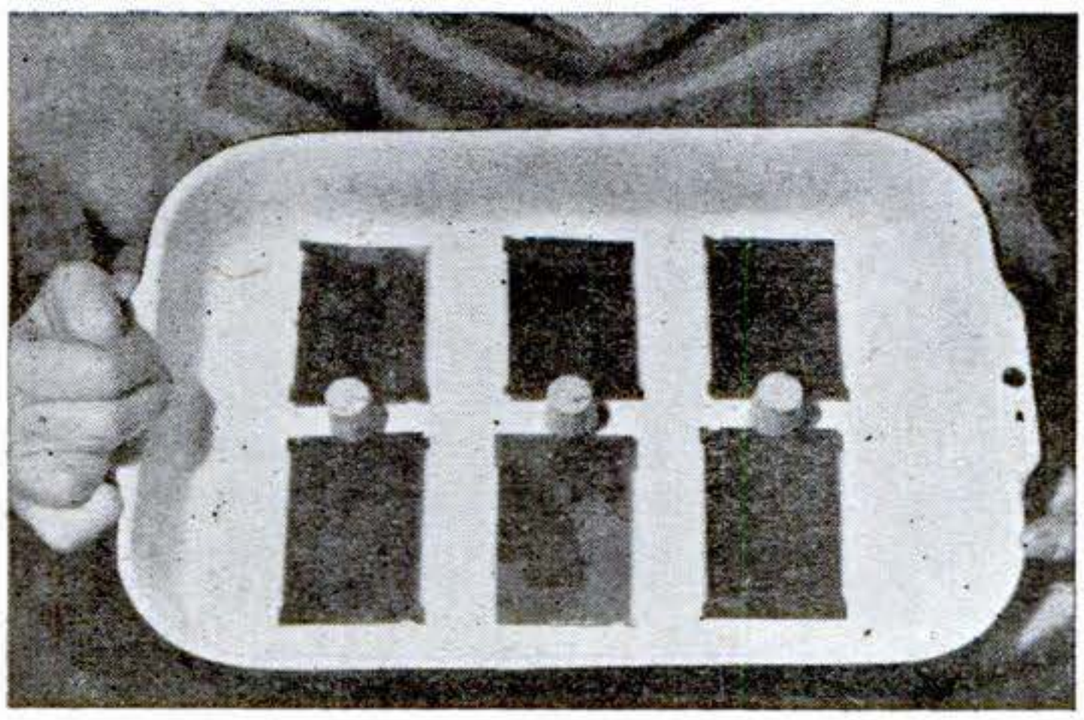
THREE WHEELS from an old wagon were used to make this king-size drum for drying movie negative and positive or reversal film. Mounted on a single axle, the wheels are held in place by wood strips bolted to the rim. Interior wire stays furnish additional rigidity. An electric motor revolves the drum by means of a narrow leather belt pulled taut over the wood strips near one end. Films are wound on the strips with the dull side out to keep the soft emulsion out of contact with the wood, and are rotated until dry.—PARRIS EMERY.

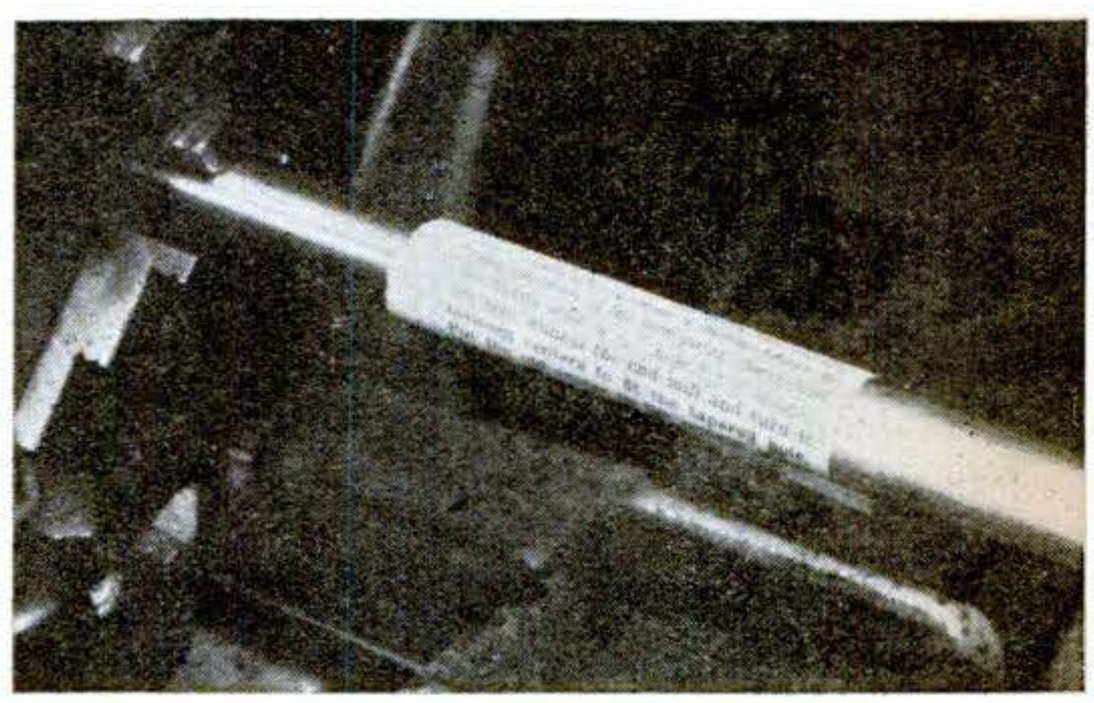


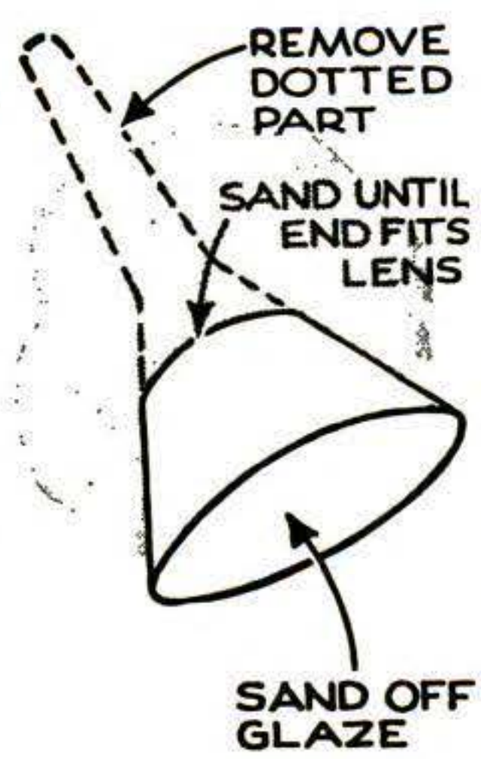


TRAY DEVELOPMENT of cut film is entirely practical if a tank is not at hand, but there is some chance of scratches and emulsion damage. To protect films from each other during agitation, spacer corks may be cemented to the bottom of the tray. Slits about ¼" deep on opposite sides of each cork hold the film. The corks should be attached with a good grade of waterproof adhesive. Another tray similarly equipped with corks should be reserved for fixing the films in hypo.—H. KLEIN.

FLAT BLACK PAINT for touching up or coating the interiors of cameras and other photographic equipment can be made from old phonograph records. Hammer them into bits, mix with painter's alcohol, and set the mixture away in a tightly stoppered jar for a few days before using. If the paint is not adhesive, a little shellac may be added, but be careful not to use too much or the paint will take on a luster. Use only prewar records, for some of the newer ones will not dissolve in alcohol.—ELWYN S. BRYANT.

FOCUSING AID. As illustrated below, a piece of printed matter attached with cellulose tape makes it possible to bring objects with smooth surfaces into sharp focus on the ground glass. Adjust the camera until the type is clear, using a magnifying glass if you want critical sharpness, lock the camera, remove the printed matter without disturbing the subject, and your focus will be perfect.—WILL THOMAS.





A SUNSHADE may be produced by cutting away and sanding a small black plastic funnel as indicated at the left. Cut the funnel slightly smaller than the outside diameter of the lens mount, and then rub it across sandpaper placed abrasive side up on a flat surface until a press fit is obtained on the lens barrel.—M.C.

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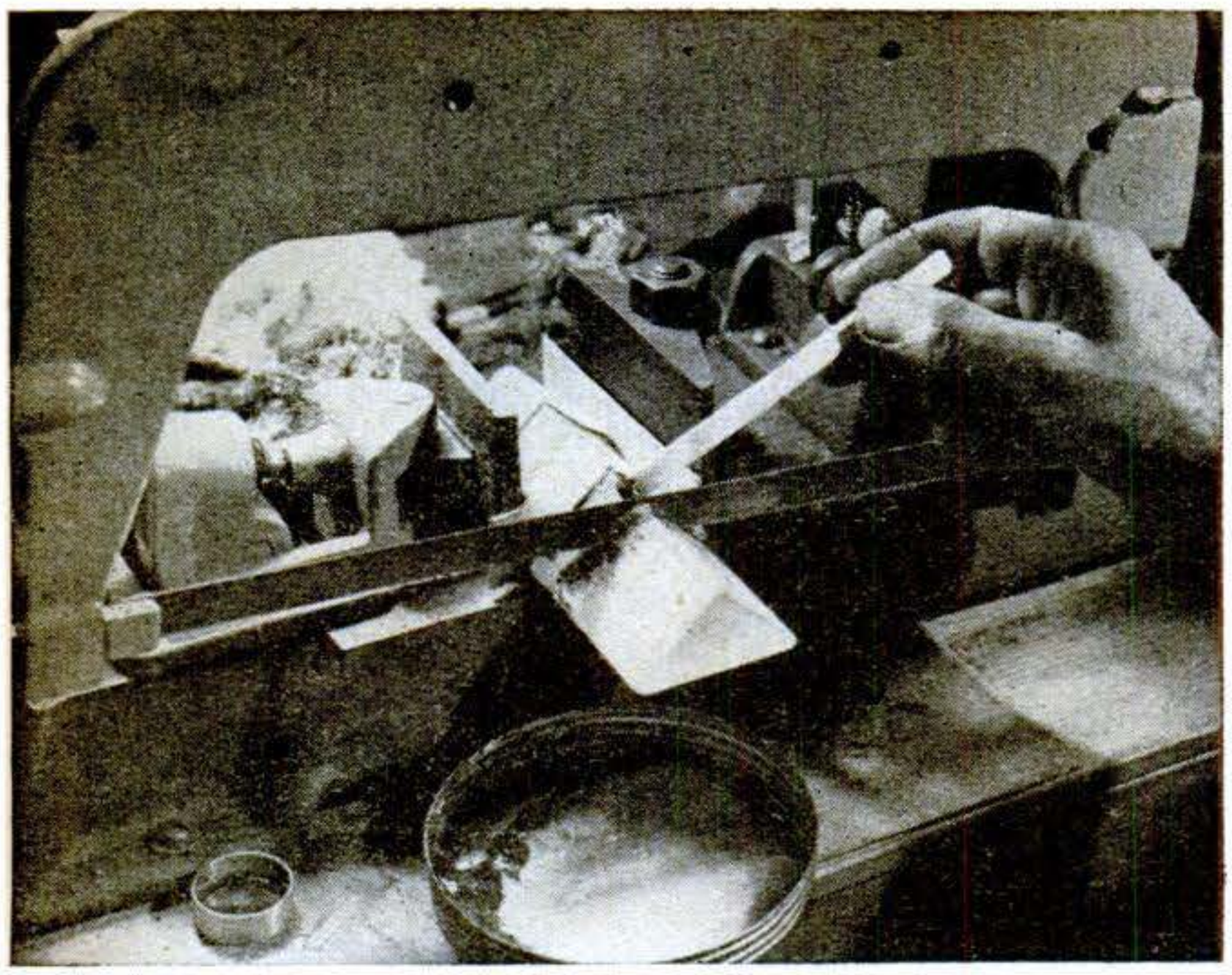
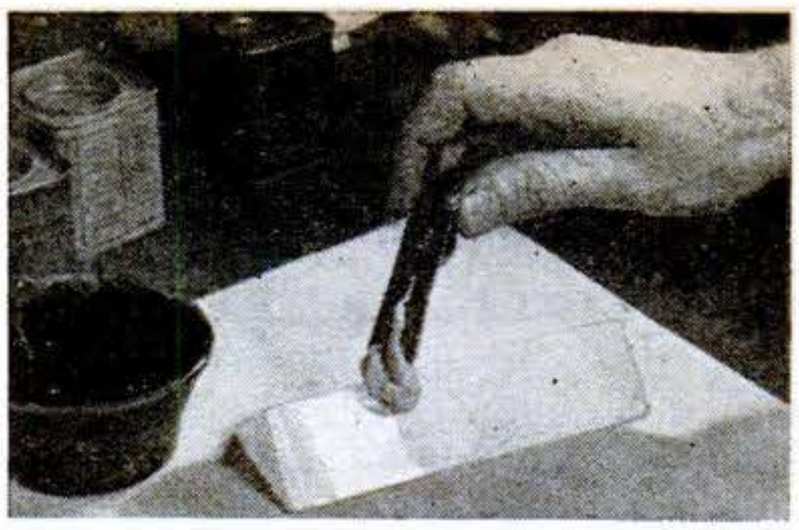
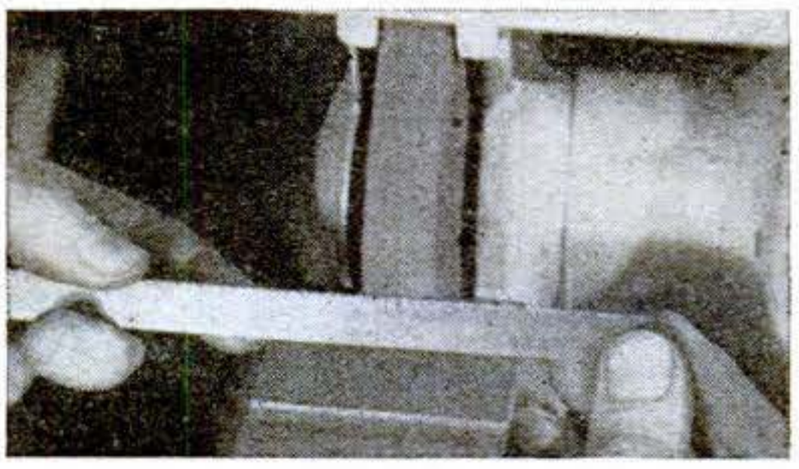


Half an hour at an easy pace was sufficient to slice through this big glass prism. A hand hacksaw would do the job, but more slowly.



Paraffin daubed on the warmed glass is one way of protecting the surface near the cut. Below, the points and set of a hacksaw blade are ground off.



Heavy Glass Objects Are Cut by Use of Hacksaw and Abrasive

THICK glass objects like prisms and solid rods can be cut with ordinary shop equipment. While one photo above shows a tank-periscope prism being cut with a power hacksaw, the job might also have been done with a hand hacksaw. You will need only a little aluminum-oxide or silicon-carbide abrasive (100 to 120 grit), some turpentine, and a worn hacksaw blade.

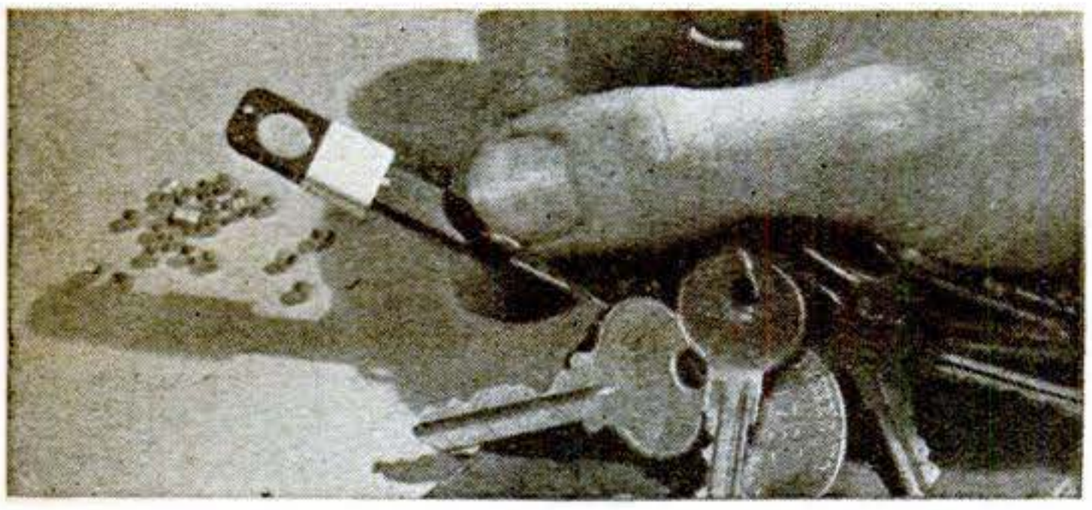
Grind off the points and set of the blade teeth, and install the blade so the teeth, now flattened stubs, are reversed from their normal inclination. In a shallow can lid place about ½ teaspoonful of abrasive mixed with 3 or 4 teaspoonfuls of turpentine. To protect the glass adjoining the cut, coat it with paraffin. Warm the glass slightly, heat the paraffin to just above melting, and swab it on.

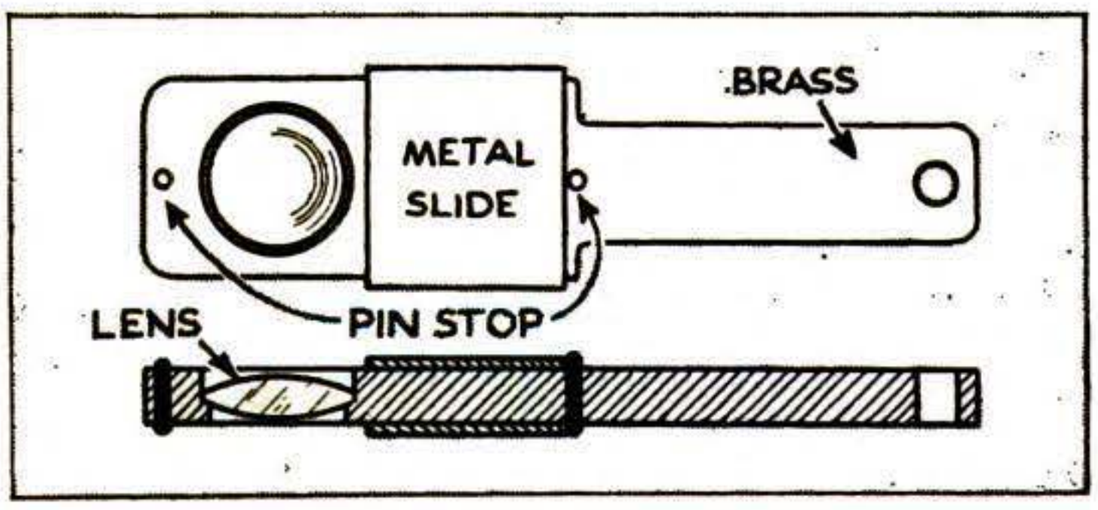
Before clamping the glass, wrap several layers of adhesive tape around it for protection, or better, embed the entire piece in a block of plaster of Paris. The plaster provides rigid support for the glass and prevents it from breaking irregularly just before the blade cuts through. Feed abrasive mixture with a wooden paddle and begin work; the glass will cut slowly but easily.

Variations on this technique include the use of a copper strip instead of a blade (it will hold the abrasive better but may show a tendency to stretch or buckle), a thin metal disk revolved at slow speed in the drill press, or an iron or copper wire as a blade in the jigsaw.—W. E. B.

Small Lens in Protective Mount Is Handy Pocket Magnifier

COUNTLESS uses will be found for a key-ring magnifier so tiny that you can easily carry it with you at all times. This one employs a war-surplus lens, 9 mm. in diameter and affording a theoretical magnification of 13½ diameters. Brass or plastic ⅛" thick will serve for the paddle-shaped mount. Bore it a trifle less than the lens diameter and then counterbore it half way through to take the lens, which is cemented in. Make the sliding cover from thin sheet metal, and provide two pin stops for it.—W. B.





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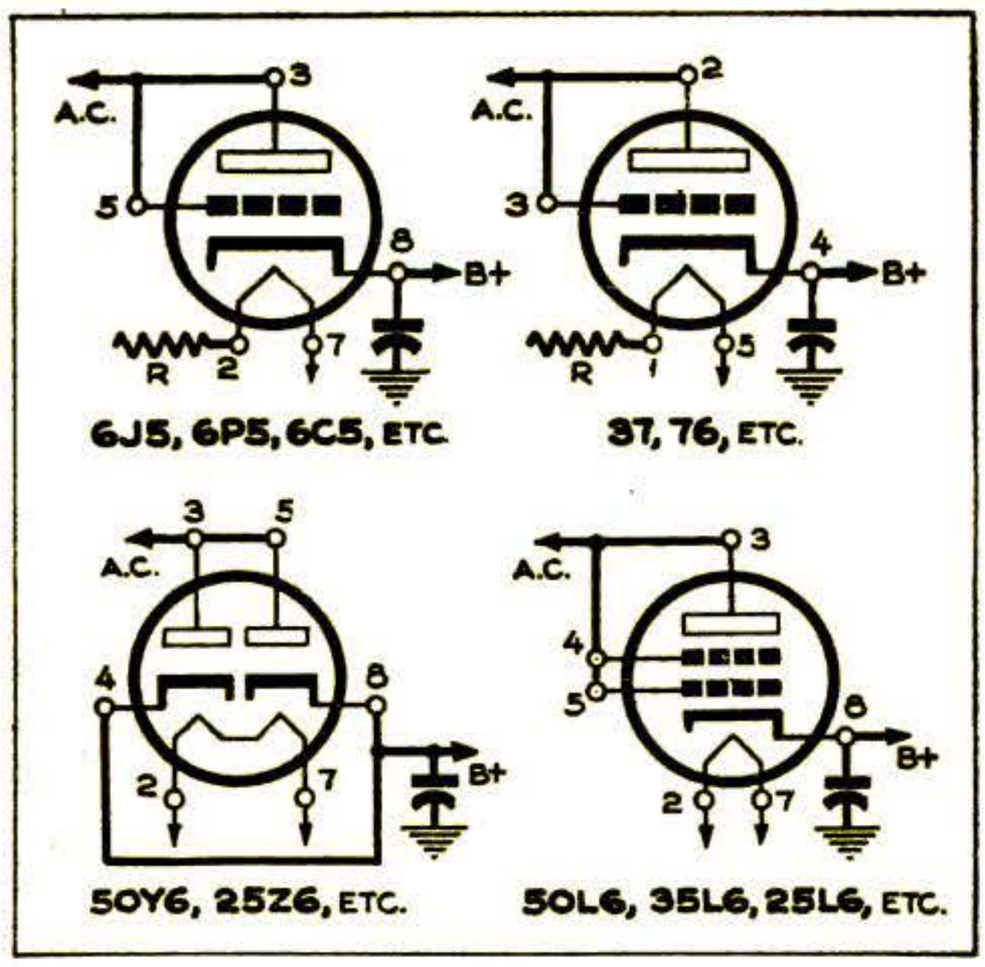
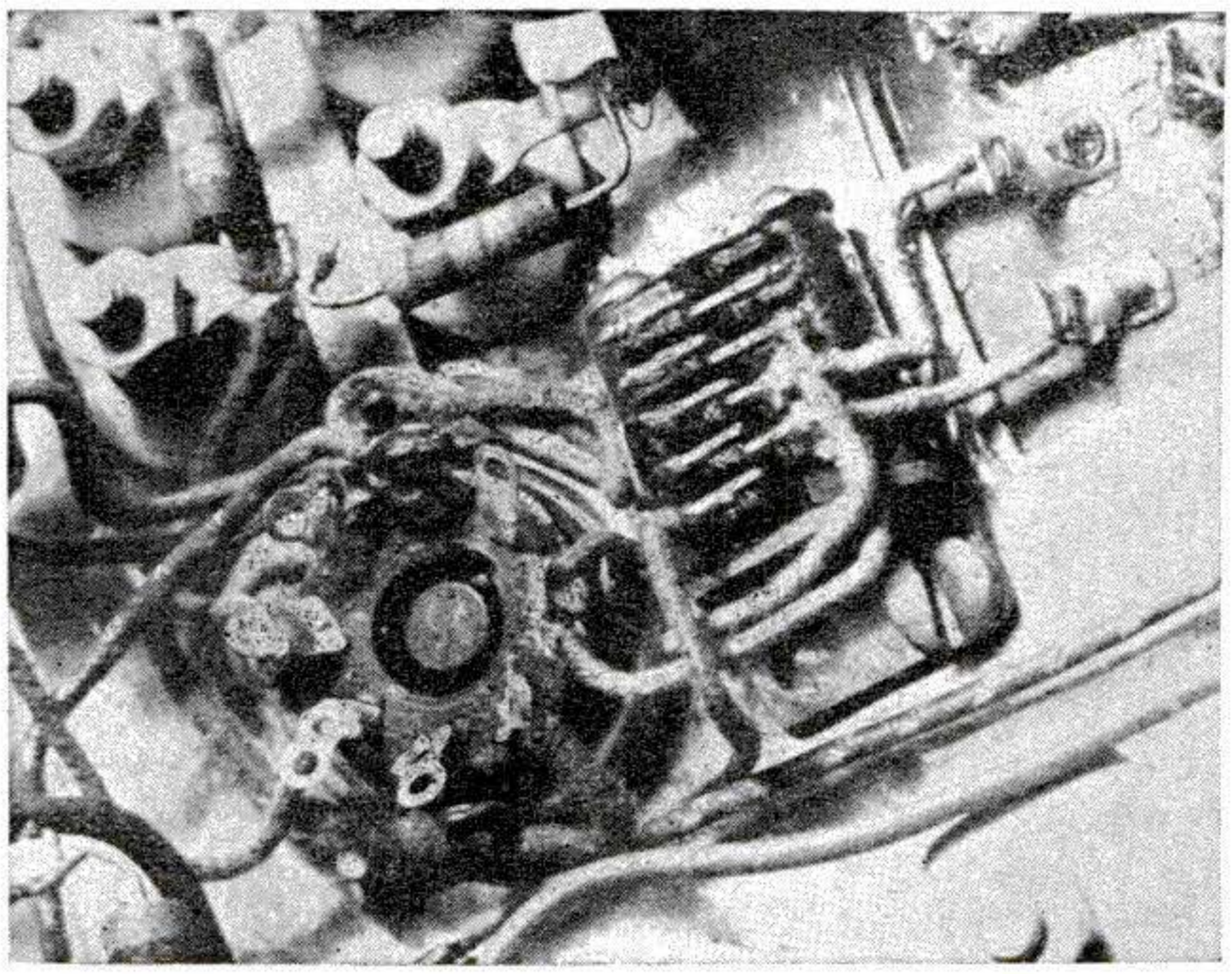
Worn-Out Tubes Are Salvaged As Rectifiers with Few Changes

RADIO tubes that drop off in efficiency or introduce unwanted noises into the receiver may have to be replaced even though they are not actually burned out.

Many such tubes can be reused as rectifiers by reducing the effective number of circuit elements to the two found in a simple diode.

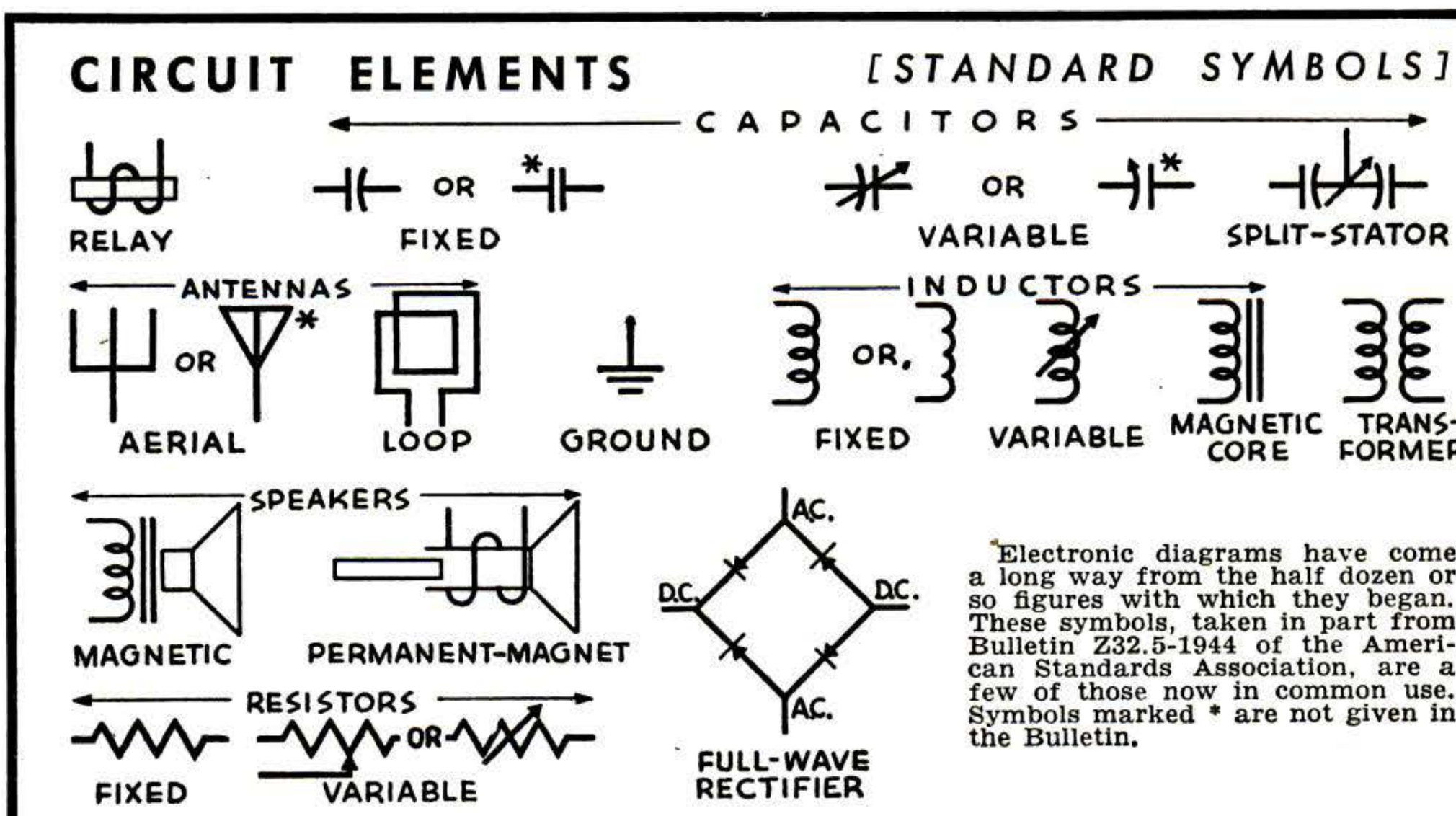
Some tube types, illustrated at the right, can be converted by means of the changes shown. The beam-forming plates of the L6 series of amplifiers have been omitted since they are not affected by the changes. In some cases it may be necessary to insert a voltage-dropping resistor in series with the filament.—WALTER ANDERSON.





Copper-Oxide Rectifier Used for Bias Voltage

BIAS voltage may be obtained in certain types of equipment by lifting the filament line from ground and installing a copper-oxide rectifier. Conventional cathode-resistor bias is ineffective in circuits where plate current either doesn't flow or is intermittent—for example, relay or photocell hookups—and a voltage divider may cut the plate current. A rectifier across the filament is, in effect, a small power-supply bias that does away with the need for an extra D.C. source to serve this purpose.—GEORGE O. SMITH.



Electronic diagrams have come a long way from the half dozen or so figures with which they began. These symbols, taken in part from Bulletin Z32.5-1944 of the American Standards Association, are a few of those now in common use. Symbols marked * are not given in the Bulletin.

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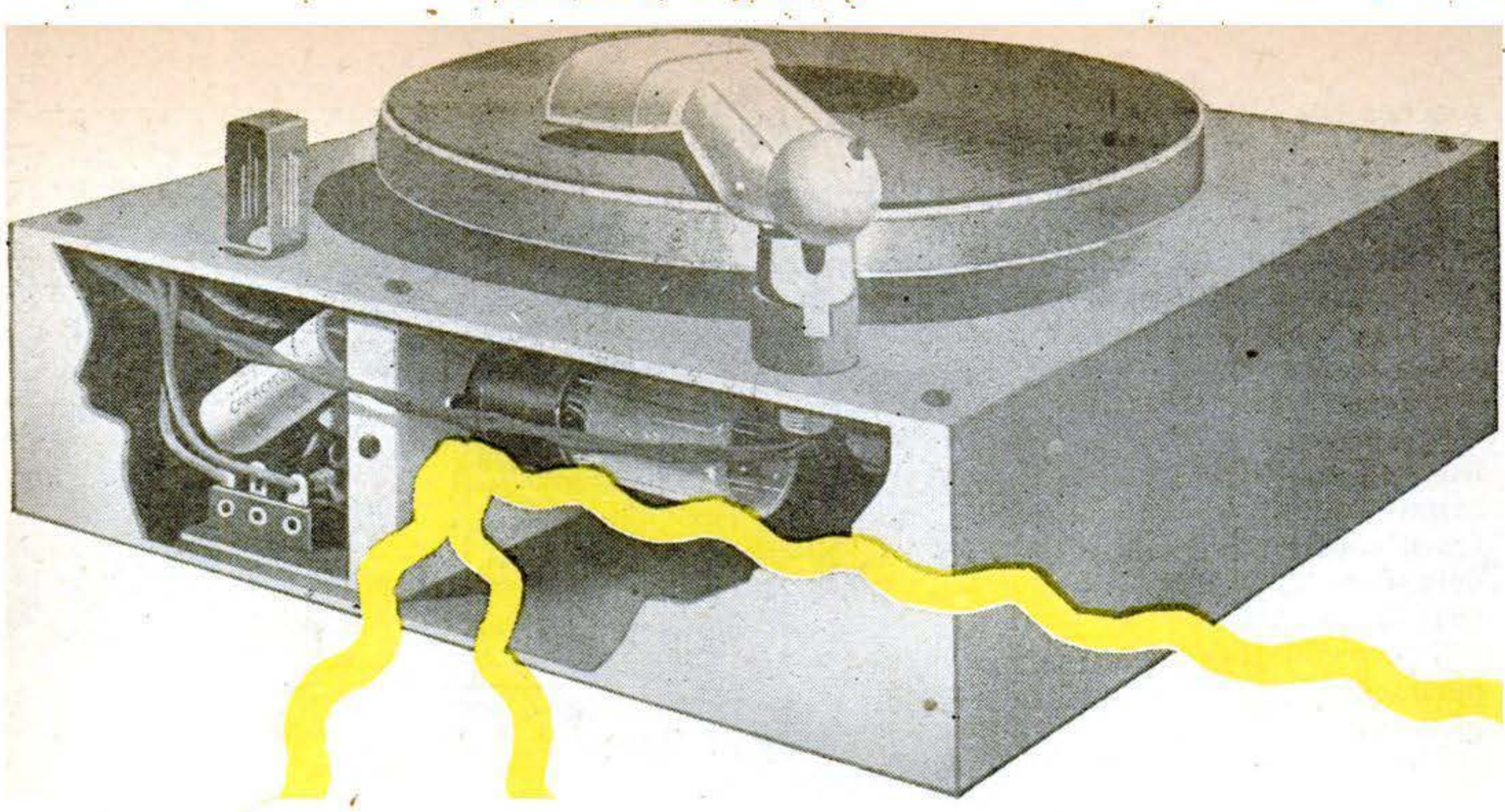

Wireless Record Player

BROADCASTS THROUGH YOUR RADIO

By Albert W. Hellenthal

HAVE you banished your old hand-wound phonograph to the attic because radio has spoiled your ear for its tinny sound? If so, here's your chance to modernize the forgotten antique, and for a few dollars give it a tone as good as that of your radio. Exactly the same tone, in fact, for it will play records through your radio. From basement to attic, any radio in the house can be tuned to pick up records played on the unit, so the entire family can enjoy favorite selections even though not gathered in one room.

The heart of the record player, a one-tube oscillator small enough to fit into the palm of your hand, is actually a tiny broadcasting station. It emits a radio-frequency carrier wave on which are impressed the audio frequencies comprising the recording.

Assuming that you have none of the necessary parts in your scrap box, total cost for the oscillator should be about $5. Add to this the cost of a crystal pickup—say another $5—and you're all set. Some of the parts have been pretty scarce for the past few years, but many supply houses have again begun to stock the most important items you will require.

Compactness and simplicity of design are obtained chiefly through the use of a single multipurpose tube designed for use on 115-volt house current. A 117N7 tube is shown in the diagram, but a 117L7, 117M7, or 117P7 can be used equally well with a few minor changes in the socket connections. The diode section of the tube rectifies A.C. into a D.C. power supply which is filtered through R5, R6, C7, and C8. As with any A.C.-D.C. circuit, direct current goes through the rectifier relatively unchanged.

Radio-frequency (R.F.) currents are set up in the tank circuit, which consists of a small trimmer condenser (C2), and one winding of an adjustable iron-core oscillator or antenna coil (L). Some experimenting may be necessary to find the correct connections. Varying either the core or trimmer or both will change the oscillator frequency.

Transferred to the secondary of the coil and applied to the control grid of the amplifier section, this R.F. constitutes the "carrier wave" of your transmitter.

Vibration in the needle of the pickup causes a varying pressure to be exerted on the crystal. Through an effect known as piezo-electricity, these mechanical vibrations are converted into alternating voltages that vary at audio frequencies. When this audio signal is applied to the screen grid, it alters the carrier wave, and it is the modulated wave that

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reaches the plate. From here the combined wave goes directly to the antenna and out into space. In principle, pretty much the same thing takes place in a large transmitter.

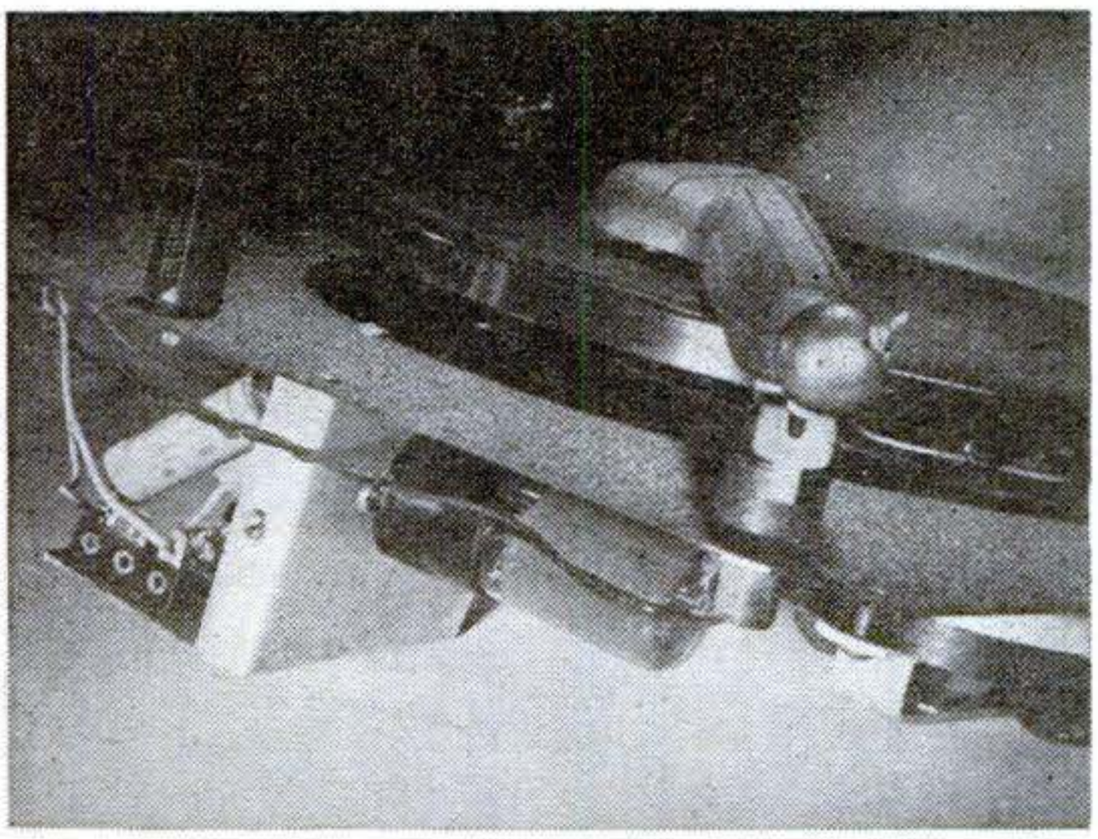
Any kind of cloth-covered wire may be used for the antenna, but it should be kept under 5′ in length to prevent the signal from radiating beyond the house. This is important, since regulations of the Federal Communications Commission prohibit unlicensed broadcasting beyond a very limited range. To insure further against radio interference either for yourself or your immediate neighbors, tune the oscillator to a frequency that is not used by any local station.

The oscillator will have to be tuned experimentally. Put a record on the phonograph, turn up the volume of both the record player (R4) and the radio, and tune the radio through its entire range. If the signal is not picked up, vary the trimmer condenser or the iron core of the coil until it is. Now select an unused frequency and keep adjusting the oscillator until the record comes through with maximum strength just at that point on the dial of your radio.

While an old spring motor is perfectly satisfactory in this unit—provided, of course, that both the spring drive and speed regulator are in good condition—it isn't necessary to use this type if you have or can get an electric turntable. With the latter you eliminate the need for hand winding, which is a troublesome and unpopular feature of the older phonographs. To install an electric motor, wire it into the circuit as shown by the dotted lines in the diagram; all the other wiring remains the same.

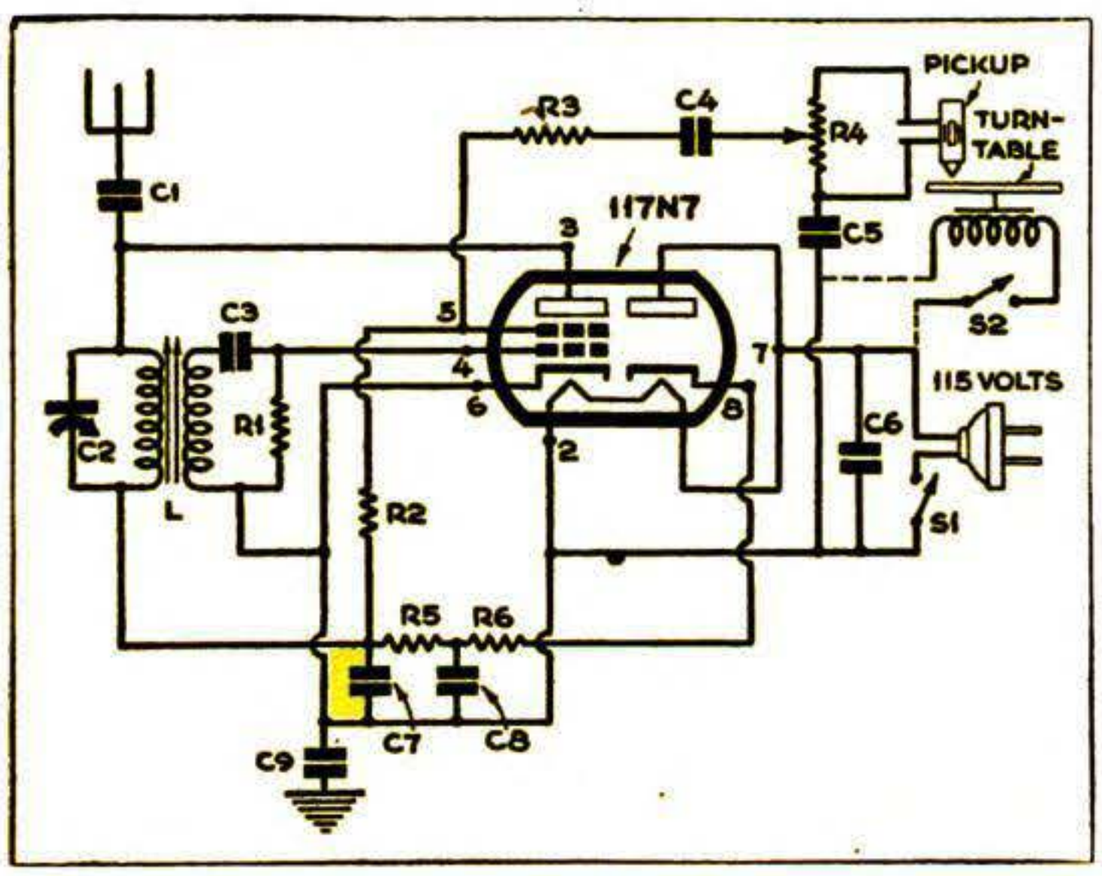
Any box or cabinet will serve to house your new record player; the tiny oscillator requires very little space and may be mounted in any position without affecting its operation. If you put the player in the original phonograph cabinet, it will be necessary to remove the acoustical pickup. This will leave a large hole which may be covered with a piece of composition board or plywood that becomes a mounting place for the new pickup arm.

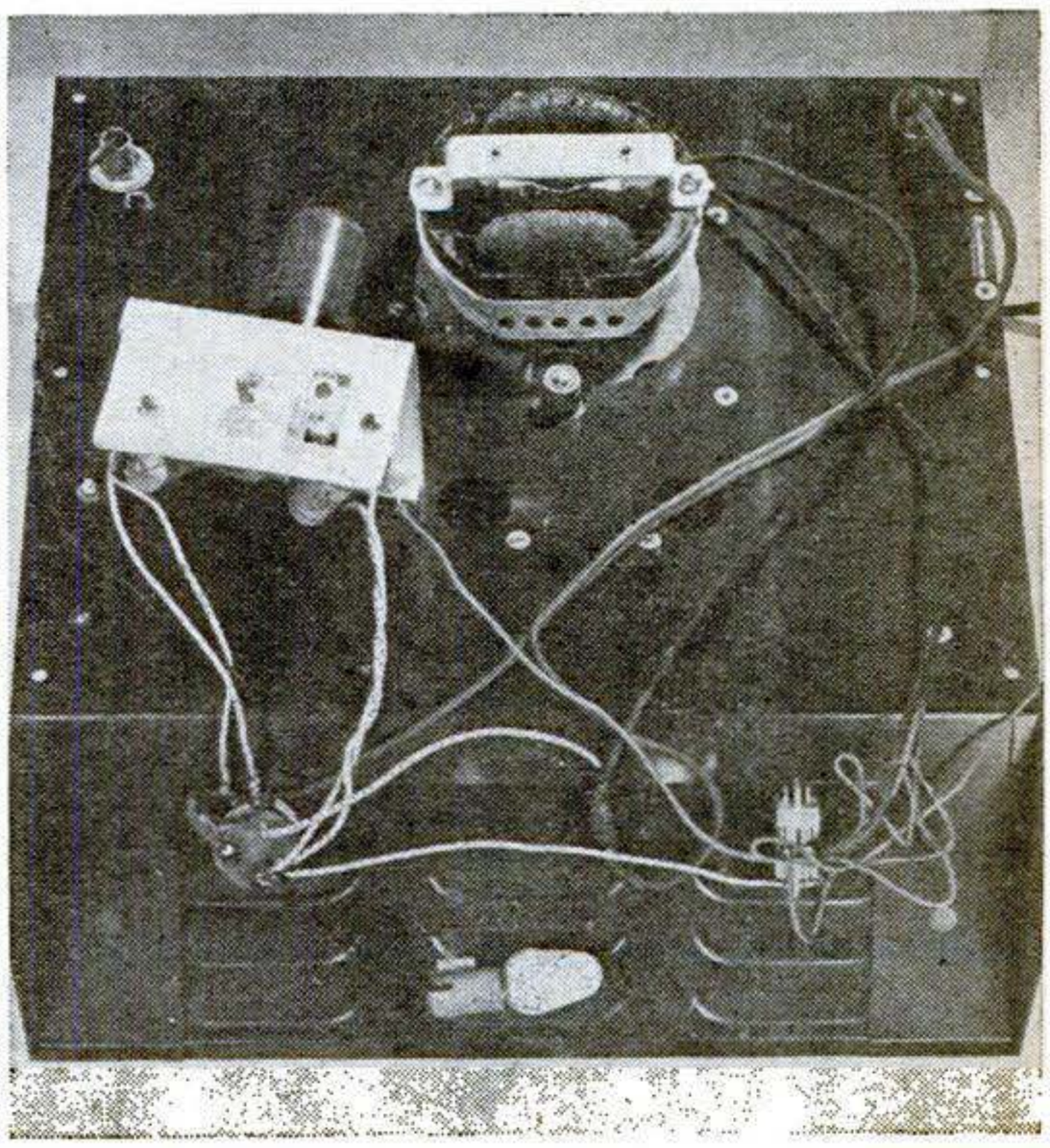
On D.C., the unit may not work as it is first plugged in. Take out the power-line plug and reverse it. You may wish to mark it for future use.



List of Parts

C1: 110 mmfd.
C2: Trimmer condenser.
C3: 250 mmfd.
C4, C5: .05 mfd.
C6, C9: .1 mfd.
C7, C8: 20-20 mfd., 150 volts.
R1, R3: 65,000 ohms.
R2: 3.5 meg.
R4: 250,000-ohm potentiometer.
R5: 10,000 ohms, 1 watt.
R6: 1,000 ohms, 1 watt.
L: iron-core osc. or ant. coil.
S1, S2: S.P.S.T. switches.
Crystal pickup.
Electric or spring-driven turntable.





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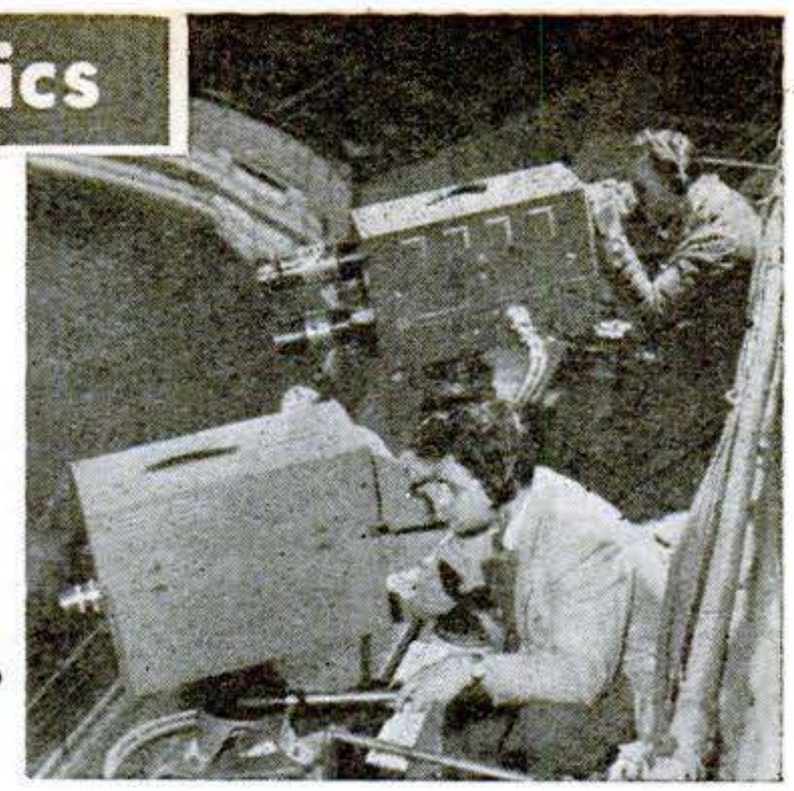
News in Electronics

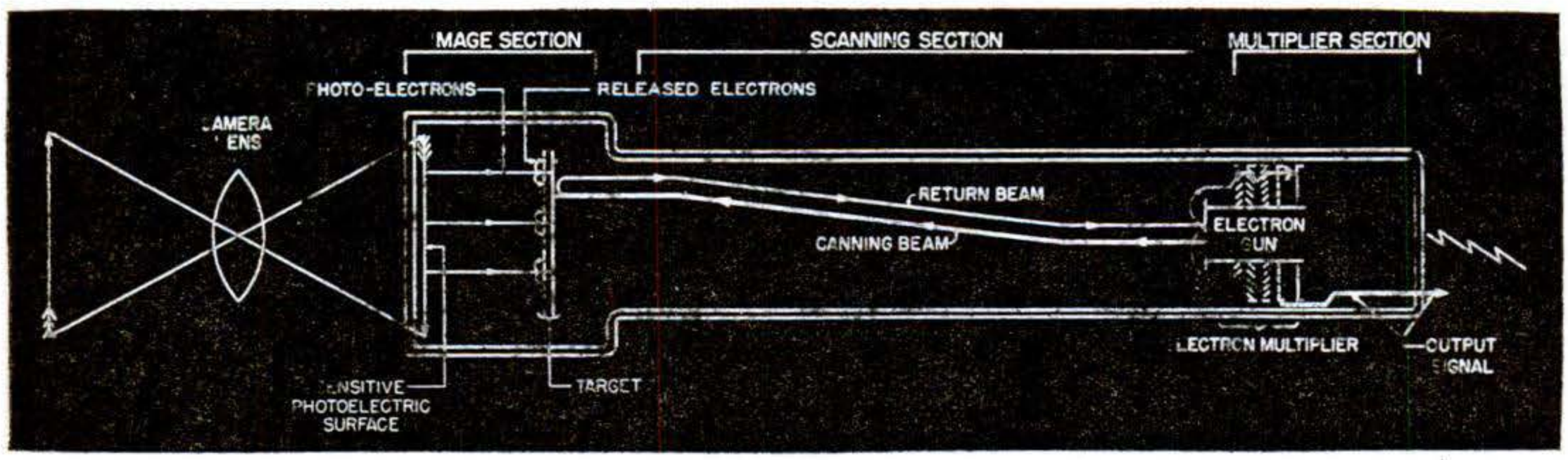
Dr. Albert Rose, engineer for RCA, holds the compact image orthicon, new super-sensitive television tube.

Televising special events with the new camera tube. Here, televisers pick up New York's famous rodeo.

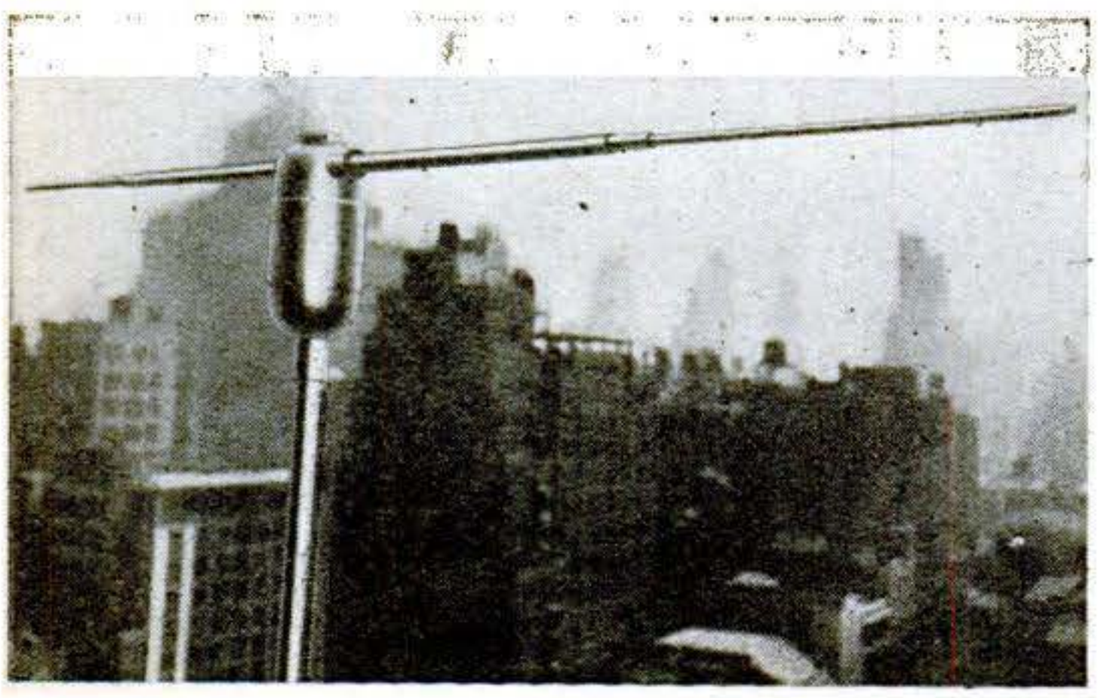


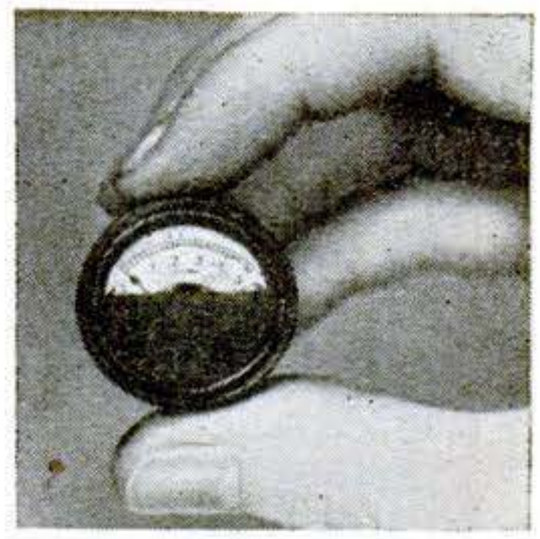
ONE CANDLE could produce all the light needed by this new television pickup tube shown above and below. Developed by RCA, the "Image Orthicon" is capable of building up a weak image into a visual signal strong enough for clear transmission and reception. As light from the subject strikes the sensitive tube face, electrons are released and directed toward the target, where each striking electron releases several more. A scanning beam replaces the extra electrons that are thus drawn off. The return beam, corresponding to the original signal, is multiplied many times and carried out to the broadcast transmitter.

Most important of the contributions that the Image Orthicon is expected to make to television broadcasting lies in freeing the camera from the limitations of elaborately lighted studios. Because less light is needed, camera lenses can be stopped down to achieve greater depth of field.



SHADOWS or "ghosts" appear on a television screen when the transmitted signal strikes an object which reflects a secondary wave. These ghosts can now be laid to rest with the Farnsworth antenna, below. Remote controls enable the user to rotate the antenna, or extend or contract its arms, until the strongest signal is obtained.





MAKING MOLEHILLS out of mountains has become a favorite occupation of electronic engineers, as witness the two midget parts shown above. The audio transformer, left, is one of a series of similar items, designed for the Signal Corps, that have been reduced to 1" in diameter. Also measuring 1" across, the meter, at right, is typical of a similar line of instruments used in aircraft and portable equipment. Both are now being manufactured for civilian uses.

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MICROTOME SLICES SECTIONS FOR SLIDE MAKING

Being able to section specimens yourself will add greatly to the pleasure of microscopy as a hobby.

BY MORTON C. WALLING

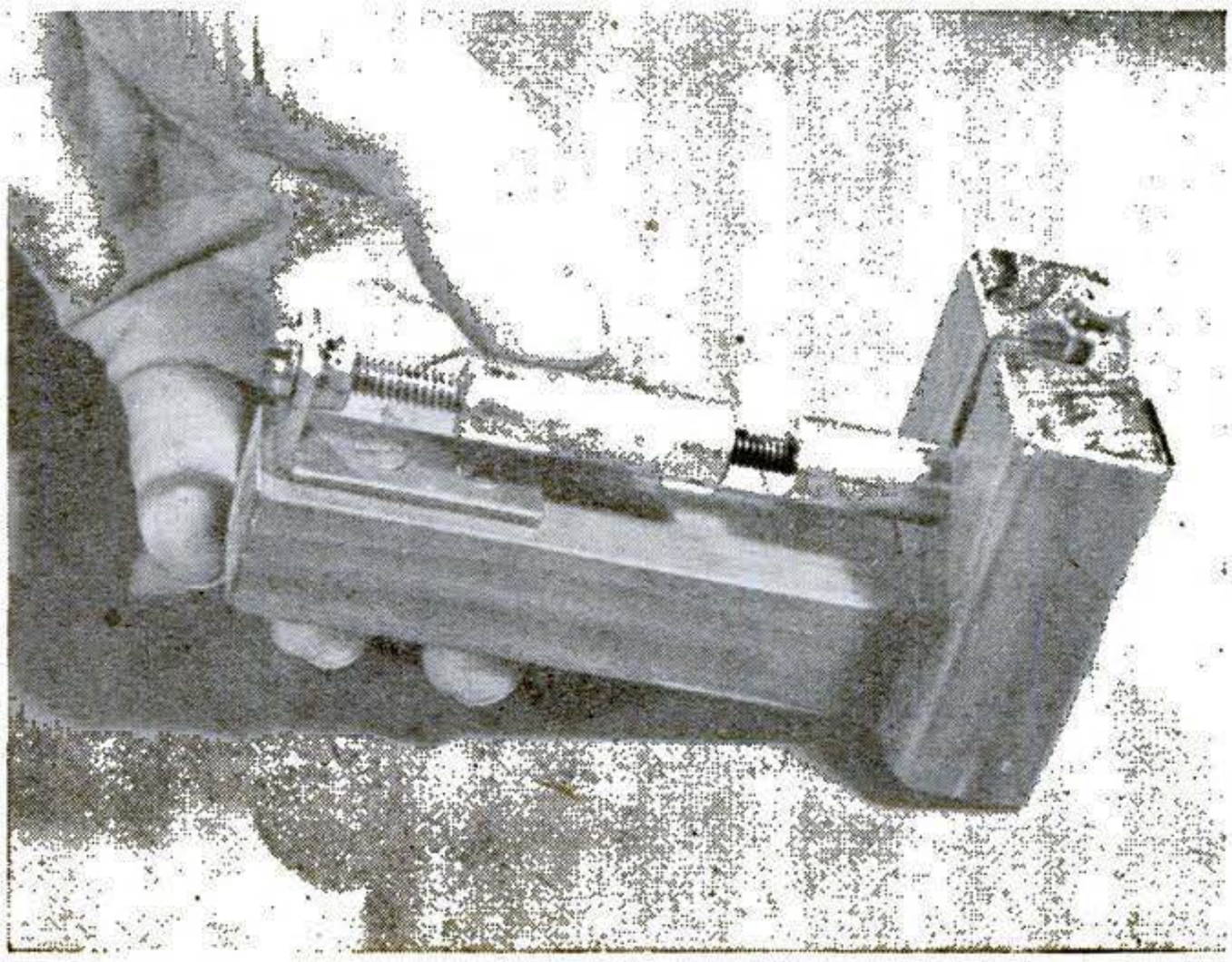
WHEN it comes to sectioning material to make your own microscope slides you will soon find that a microtome is practically indispensable. With it you can slice plant stems, leaves, fruit rind, animal tissue, and various other materials to the thickness of a few microns.

Making a microtome is not difficult. The photos and drawings show a small hand model assembled from wood, bolts, and other odds and ends. A straight razor or a safety-razor blade is used for the cutting.

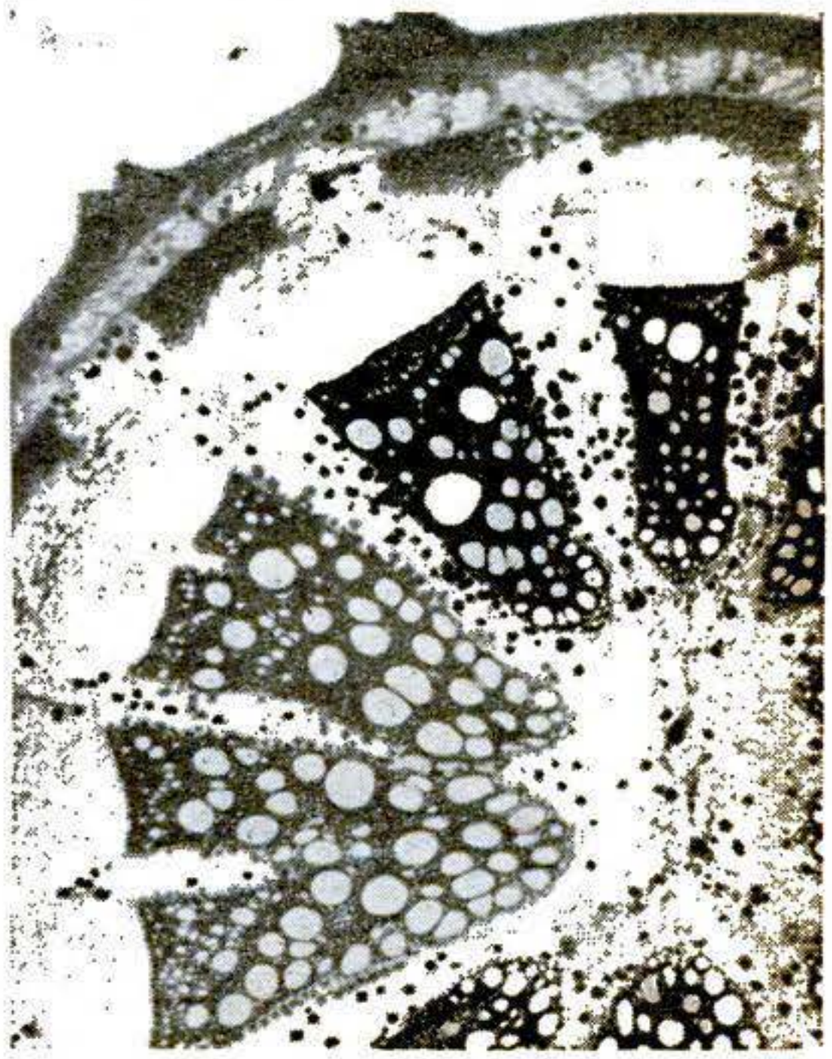
The micrometer feed, by which the specimen can be moved outward a few microns at a time between cuts, is obtained by the use of two common bolts of slightly different thread pitch. The principle followed was suggested by Alden A. Grosz, of New Orleans. A difference of about four threads per inch is satisfactory; in the microtome shown ¼"-20 and 3/16"-24 bolts were used. Other combinations differing by a few threads would do as well.

From well-seasoned wood, cut pieces for the frame to the dimensions shown in the drawing on page 195. Cut off part of one leg of a 1½" angle bracket midway between the two screw holes and enlarge the hole remaining in the stub to clear the 20-thread bolt. Screw the other leg to the wooden frame. [*Turn the page.*]

Using a microtome built with two common bolts having different pitch, sections can be sliced to the thinness of a few microns.



Dutchman's pipe vine, sectioned with a hand microtome. A beautiful stem.



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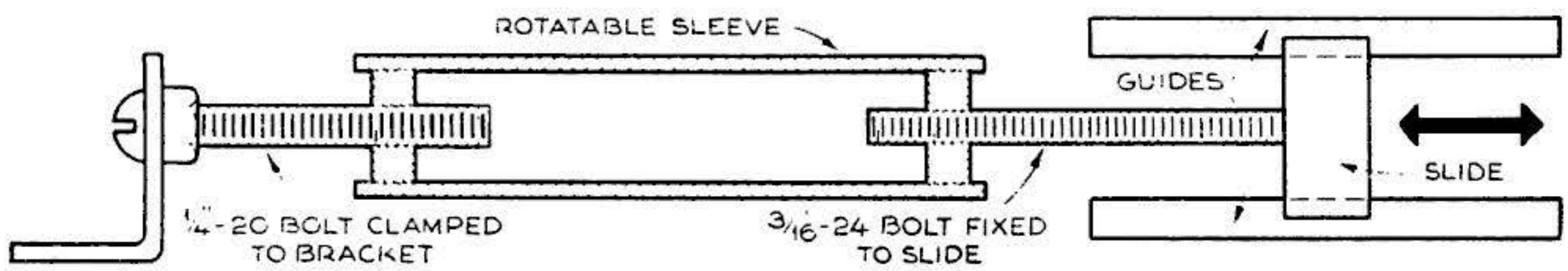
HOW COARSE-THREAD BOLTS CAN GIVE MICROMETER FEED

Here is the principle of obtaining micrometer feed by the use of two common bolts of slightly different thread pitch. When the connector sleeve is rotated, it moves on the thread of the fixed ¼"-20 bolt a distance of 1/20" (.050") for each full turn. At the same time it moves in the opposite direction on the 3/16"-24 bolt attached to the slide at the rate of 1/24" (.0417") for each turn.

The net result is that the slide moves at the rate of 1/20" minus 1/24" for each turn, or .050" minus .0417", about .008". This is the equivalent of 200 microns. The feed can of course be further reduced by rotating the connector sleeve only fractions of a single turn. In order to facilitate this, the periphery of the sleeve can be calibrated in any number of even divisions. —ALDEN A. GROSZ.



The specimen is held in a brass tube having an outside diameter of about ½". At a point in the wooden endpiece in line with the bolt hole in the angle bracket, bore a hole into which the tube will fit snugly. Then cut a slot about 3/16" wide from the hole to the outer end and fasten the two wooden parts together with glue and brads.

One end of the specimen tube should be closed by a plug drilled and tapped to receive the end of the 24-thread bolt. A nut soldered in place could also be used. Cut the 24-thread bolt to a length of 1⅛", screw ¼" of it into the tube, and solder it in tight. Next, cut the 20-thread bolt to a length of 1¼", run it through the hole in the angle, and lock it with a nut.

The two bolts are joined by a long, cylindrical sleeve or connector that is rotated to move the specimen tube in either direction. One way to make this connector sleeve is to drill a ½" by 1⅝" brass rod and thread half its length to fit the 20-thread bolt and the other half to fit the 24-thread bolt. Another way is to solder nuts in the ends of a piece of similar-size tubing. Pains must be taken to have the threaded holes in alignment. Roughen the outside of the connector by knurling or by rolling it with considerable pressure between a coarse file and a board.

About ⅜" from the open end of the specimen tube solder a 6-32 nut filed down to move easily in the slot in the wooden block. Drill through the nut into the tube with a No. 36 twist drill and run a 6-32 tap through the nut and hole. Then install a 6-32 thumbscrew 1¼" long. A knurled head for such a screw can be made by soldering on a binding-post nut. Cut a ⅜" wide strip of sheet metal slightly shorter than the cavity in the tube to fit inside and serve as a partition between the clamping bolt and such specimens as plant stems.

Assemble the microtome by running the connector on the 24-thread bolt as far as it will go, sliding the tube in, and turning back the connector to engage a thread or two of the 20-thread bolt. Make a punch mark on the connector so you can judge more easily when making fractions of a turn. When sectioning elder pith, for example, a quarter or one-third turn may be used for each cut.

To give a smooth bearing surface for the razor blade, cement two ¾" by 2½" pieces of glass to the piece flanking the specimen-tube hole. They may be cut from microscope slides. The tube should be a fraction of an inch below the glass when the connector is all the way on the 24-thread bolt.

To cut a section, run the connector all the way on the 20-thread bolt, clamp the specimen in the tube, make one or two leveling cuts, and then turn the connector to move the specimen outward the desired amount. Slice with the razor blade held firmly against the glass and moved diagonally on it.

An old-fashioned straight razor is probably best for slicing, particularly if it has straight sides instead of being hollow ground. Safety-razor blades are most easily used when clamped in some sort of handle.

You can section such materials as elder pith, plant stems, and balsa wood without special preparation. Soft animal tissue and the like should be embedded in paraffin, a process described in most textbooks on microscopy and some on biology. The paraffin block may be trimmed to fit the tube or mounted on the end of a wooden plug or dowel of suitable diameter.

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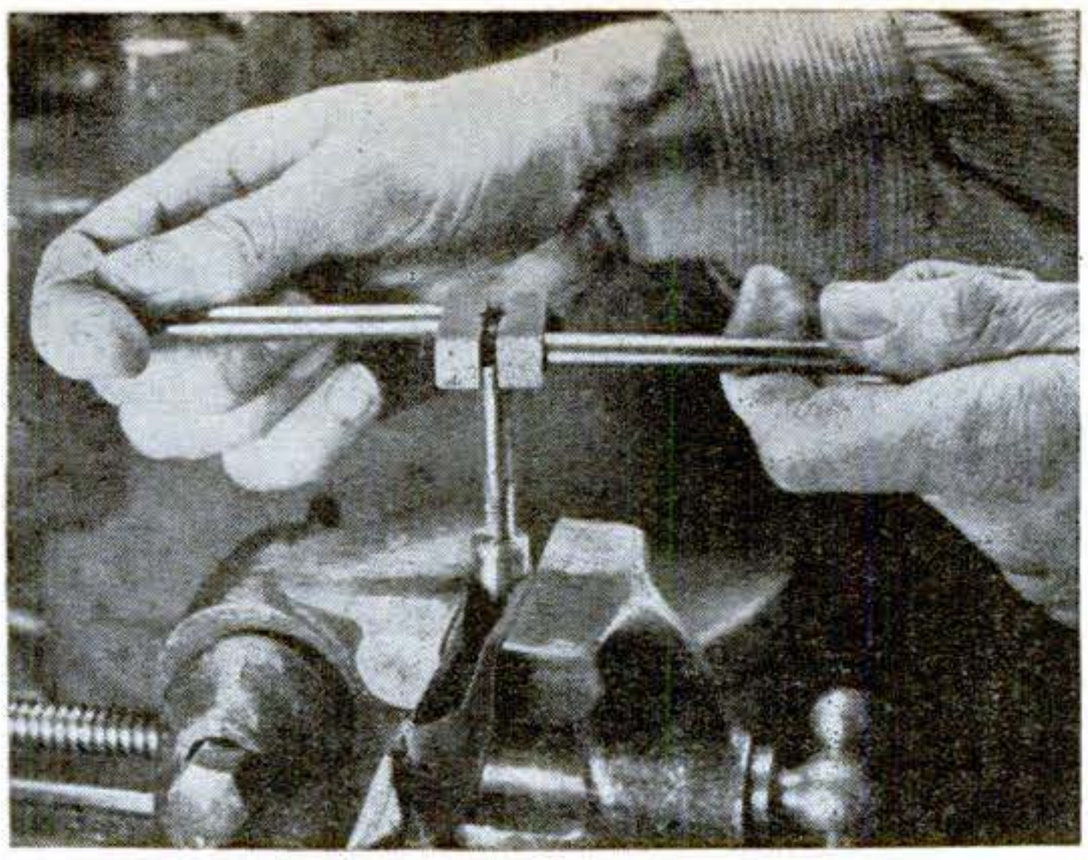
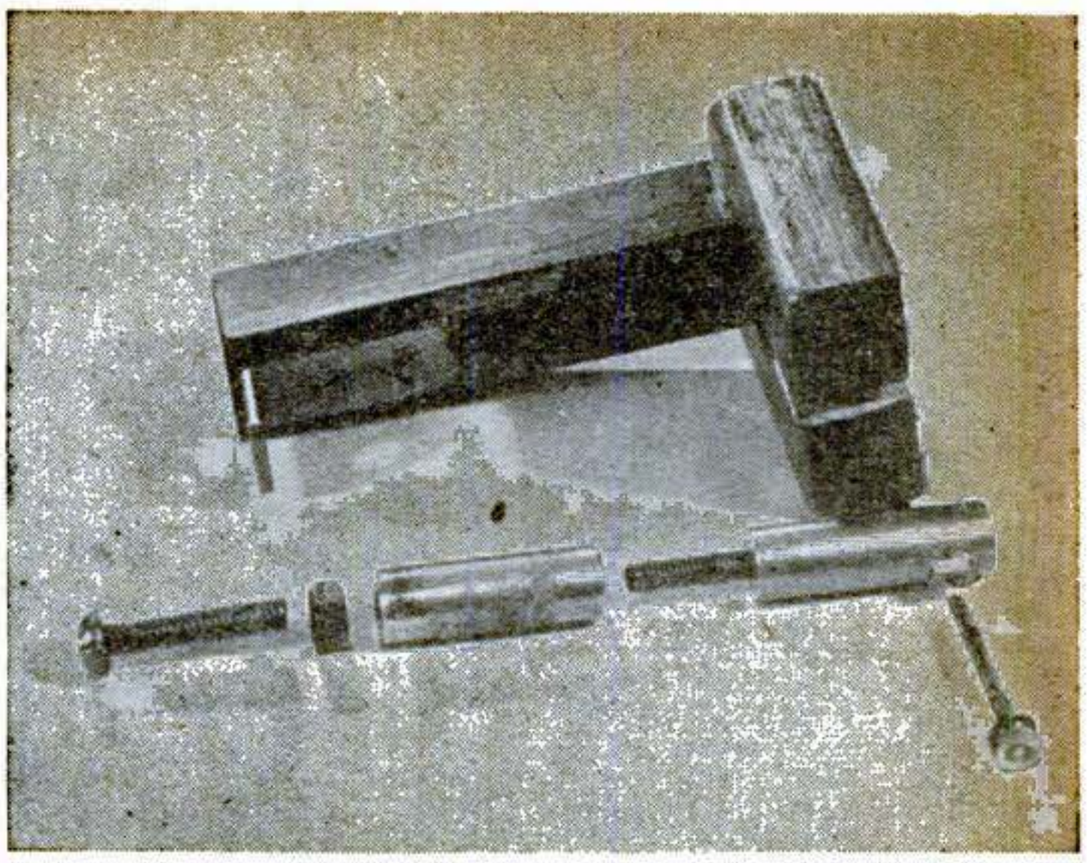
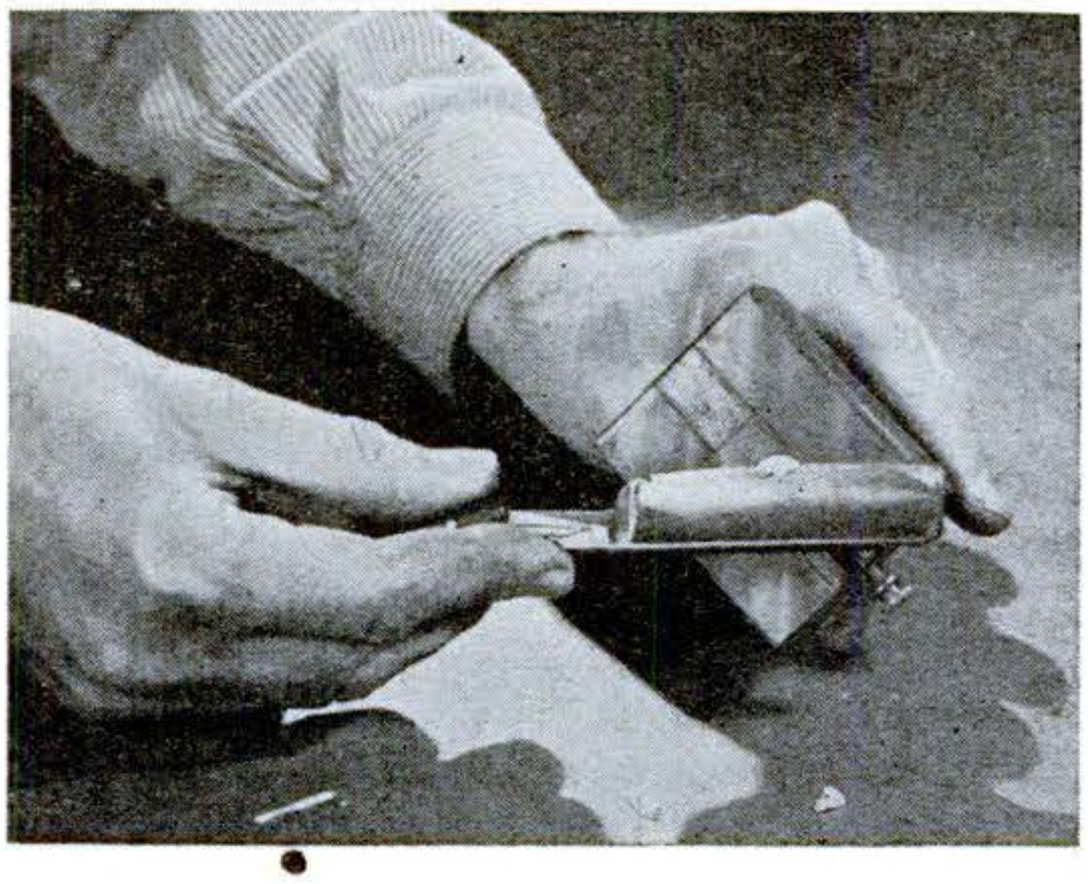


Threading the bolt hole in the connector sleeve of the microtome. It is threaded half its length for a 20-thread bolt and half for one of 24 threads.

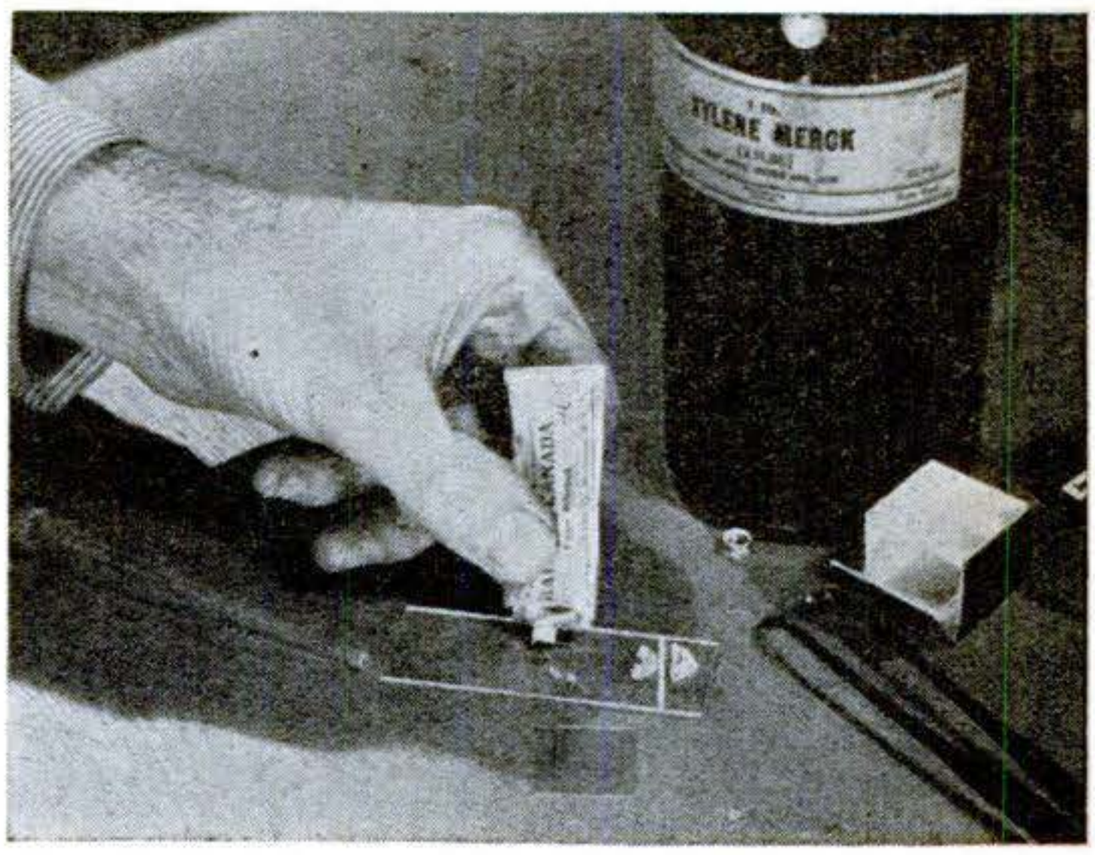


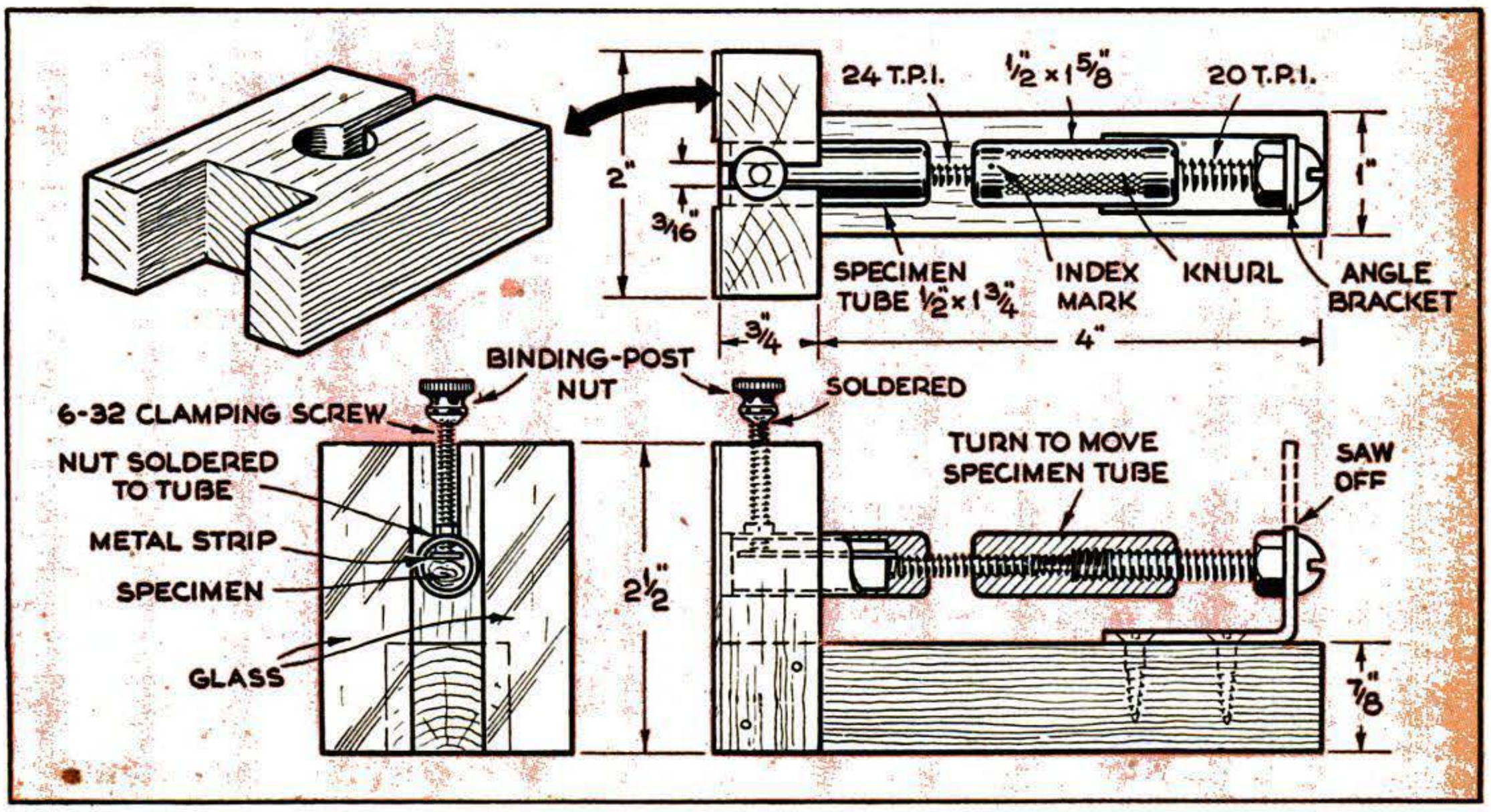
Parts of the hand microtome. The assembled frame and, left to right, a 20-thread bolt, nut, sleeve, 24-thread bolt, specimen tube, and clamping bolt.

When the specimen tube is advanced the distance desired, the section is sliced off with a razor.



Placing a drop of Canada balsam on a glass slide for the permanent mounting of elder-pith sections.





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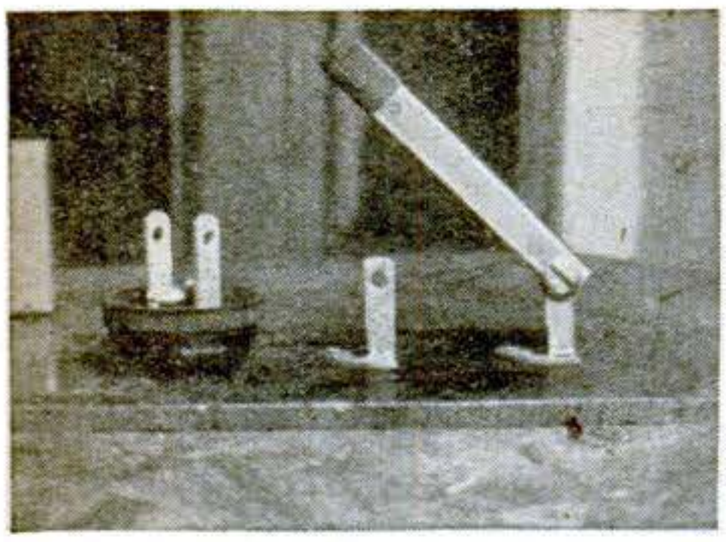
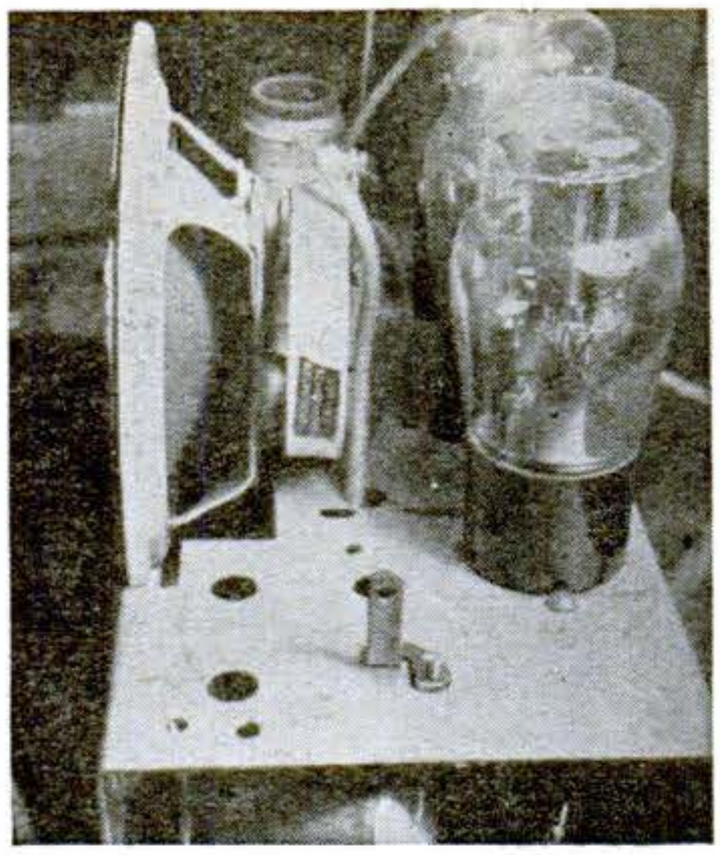
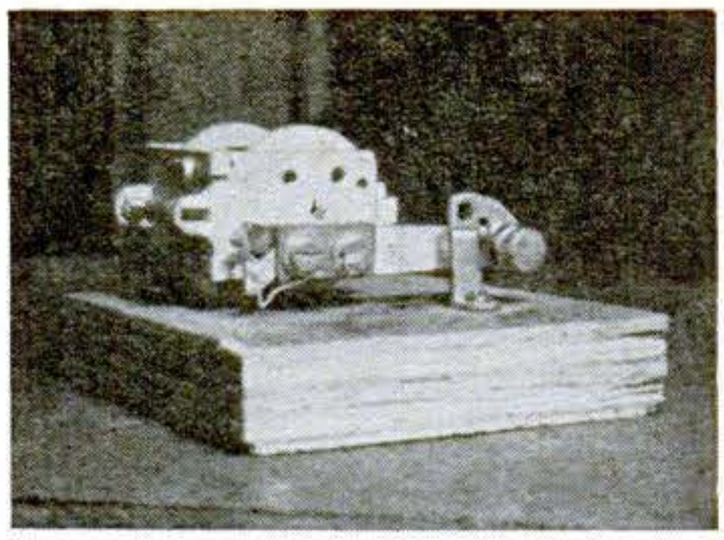
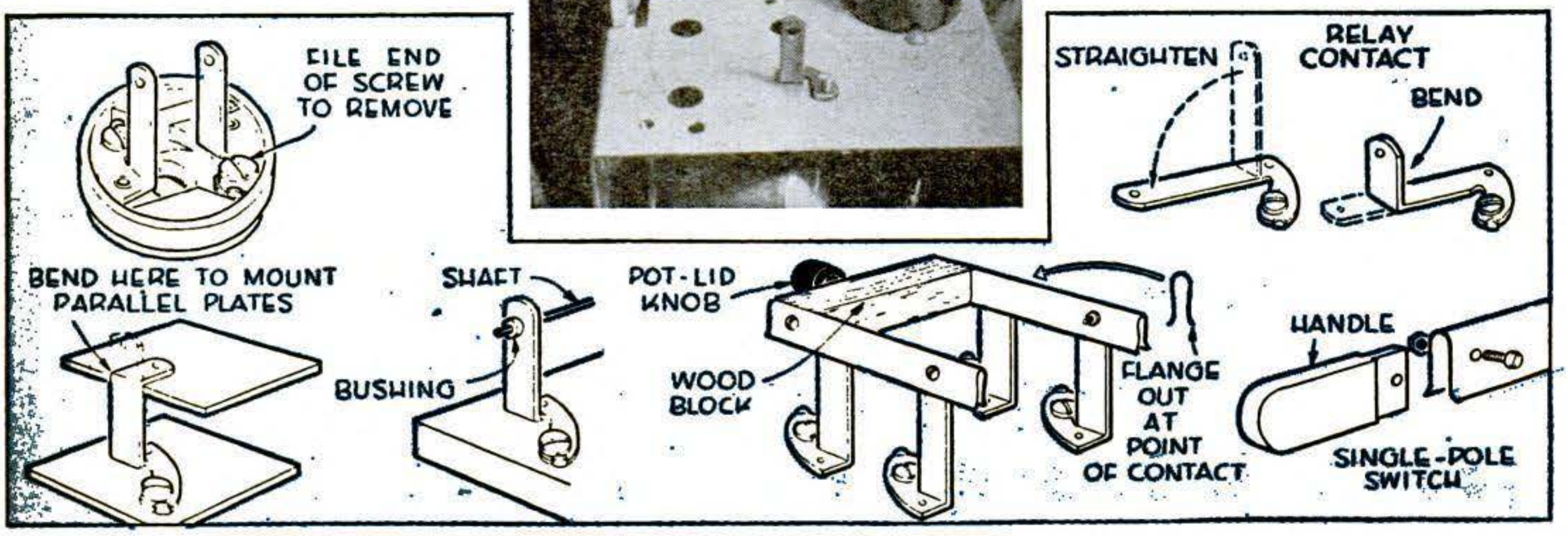
Prongs from Broken Electric Plugs Fill Many Workshop Needs









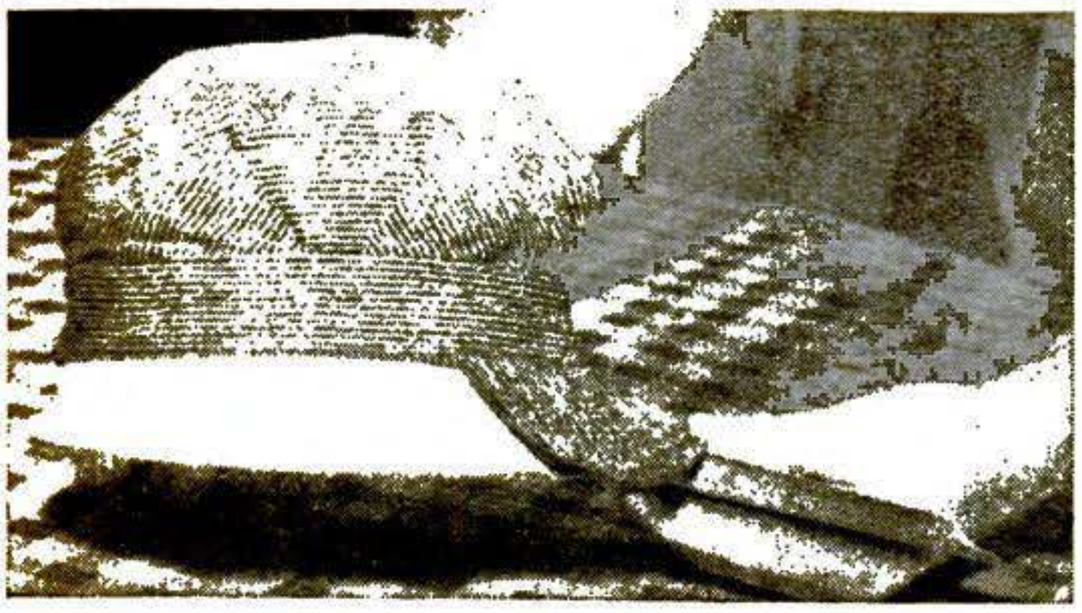
EXPERIMENTERS can find many uses for prongs taken from cracked or broken electric plugs of the type illustrated above. Remove the screws or rivets that hold the metal to the plastic housing, and file off the burred ends of the wire-retaining screws. You will then have 90-deg. metal angles that may be used as mounting brackets for radio parts, switch components, auto-fuse holders, bearing mounts for small shafts, and other purposes.

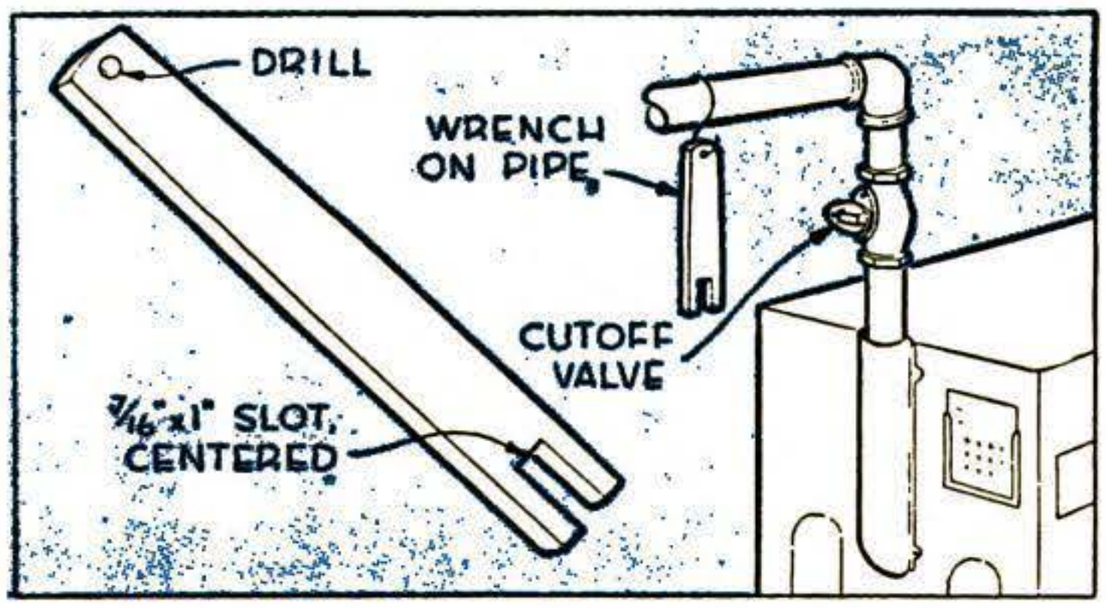
To construct a switch, mount the prongs on a base, bend a strip of ¾" copper or brass into a narrow U-shape, and attach the strip to the hinge prong with a rivet or a screw and nut as shown above. A wooden or fiber handle may be added.

By straightening the prong and bending the longer leg, an adequate mount is formed for contact points on relays, vibrators, and the like. The same arrangement serves as a stop adjustment for limiting the travel of moving parts, and for screw tension adjustment on springs and balances.—H. W.

Saucepan for Cap Blocking

WORK caps, although washable, have a tendency to shrink out of shape after cleaning unless dried with considerable care. To help your cap dry properly after laundering or dry cleaning, place it on an inverted saucepan as shown below. Stuff crumpled paper between the pan and the crown of the cap, and allow the peak to rest on the handle.—CHARLES FITZ PATRICK.





Wrench Kept by Cutoff Valve

HUNTING for a wrench with which to shut off a gas valve can easily change a minor emergency into a critical one. No precious time need be lost, however, if you keep this homemade wrench hanging near the cutoff valve at all times. It can be made of almost any piece of steel large enough to take a 7/16" by 1" slot and long enough to give the necessary leverage.—E. J. WIECZOREK.

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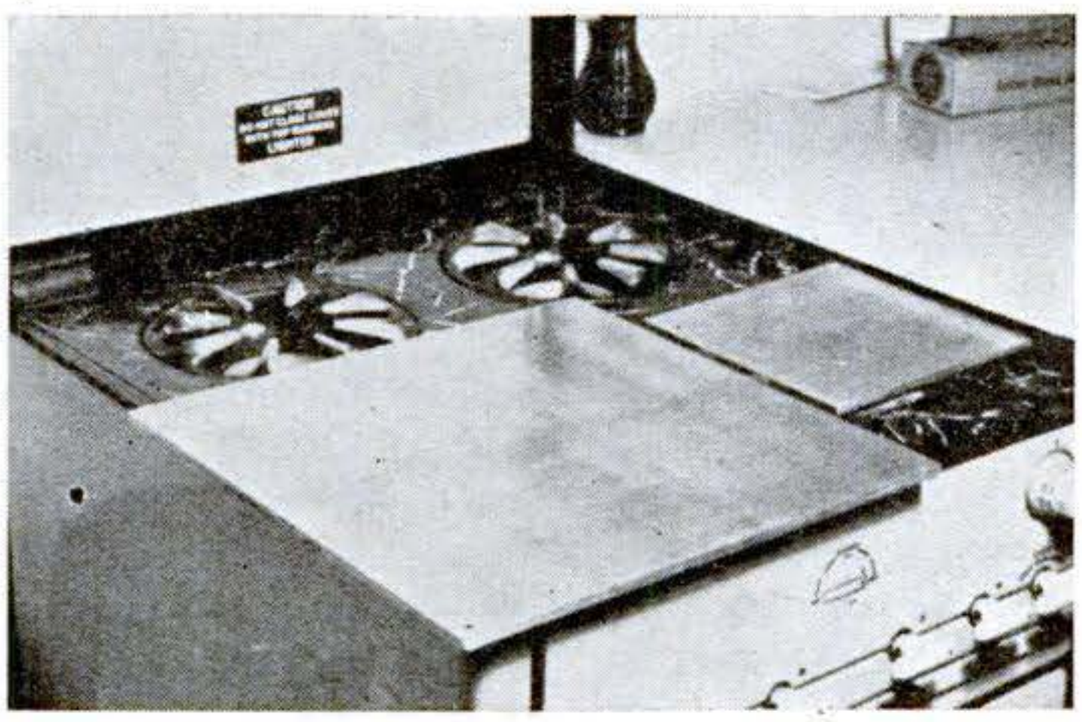
Spring Helps to Lift Heavy Cellar Door

CELLAR doors are usually hard to open and harder to close quietly, but they don't have to be. Install a large coil door spring so that its tension, instead of tending to close the door—as is generally the case—will counterbalance most, but not all, of the door's weight. Caution all persons who have to go into the cellar about the lightweight door so that it won't spring up at them as a complete and perhaps disconcerting surprise.—ANDREW VENA.

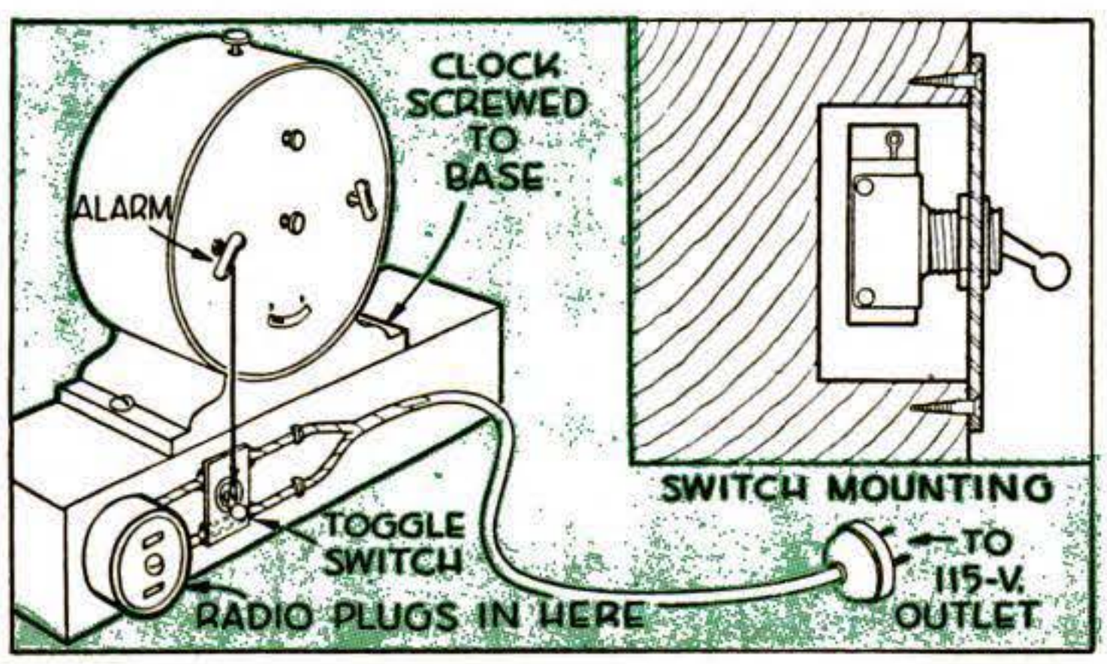


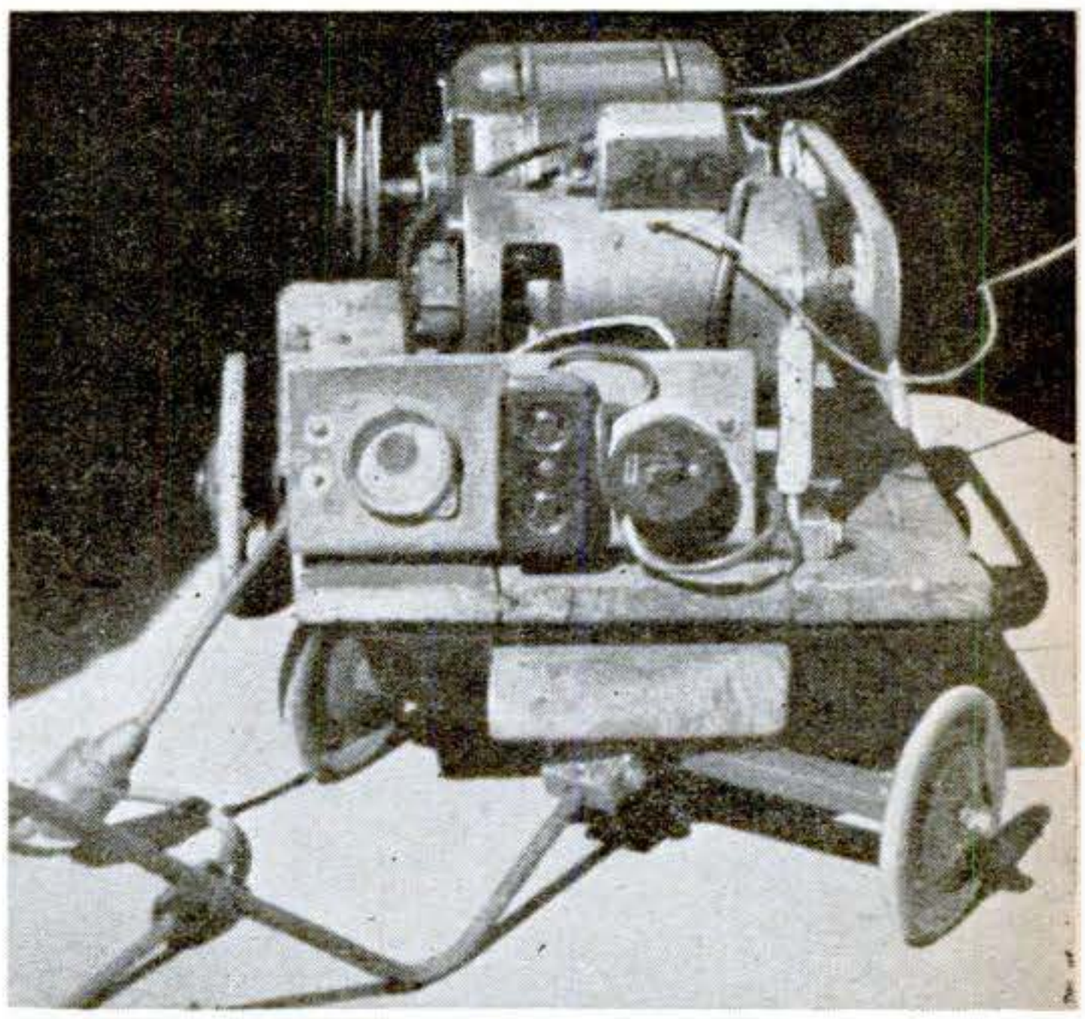
Griddle from Scrap Aluminum

PANCAKES made in a frying pan never tasted right to me, so as an alternative to discarding my griddleless gas range, I found a piece of ¼" sheet aluminum, beveled the edges, and sanded and scoured the surface. A small hole in the corner is used to hang the griddle up when not in use. Two griddles are shown at the left; the small one is used for toasting one sandwich, since no one here is interested in one pancake.—J. C. MAGEE.

Clock Controls Electric Switch

ANY type of electrical appliance can be turned on or off at a preselected time by placing a time switch in series with the current source. In the alarm-clock switch below, a string is drawn up when the alarm key unwinds, throwing the switch. Silence the alarm by removing the ringing plate or bending the hammer, mount the clock on a wooden base, and mortise the base to receive the switch. Depending on how you mount the switch, this may be either a normally on or normally off setup.—JACK HANSEN.





Battery Charger Rides on Cart

RECHARGING storage batteries used to require that I bring them to my motor generator. I speeded up the job considerably by reversing the process. With a portable charger mounted on a cart supported by toy wagon wheels, I can now boost batteries without removing them from the cars I am servicing.—FRANK R. COLE.

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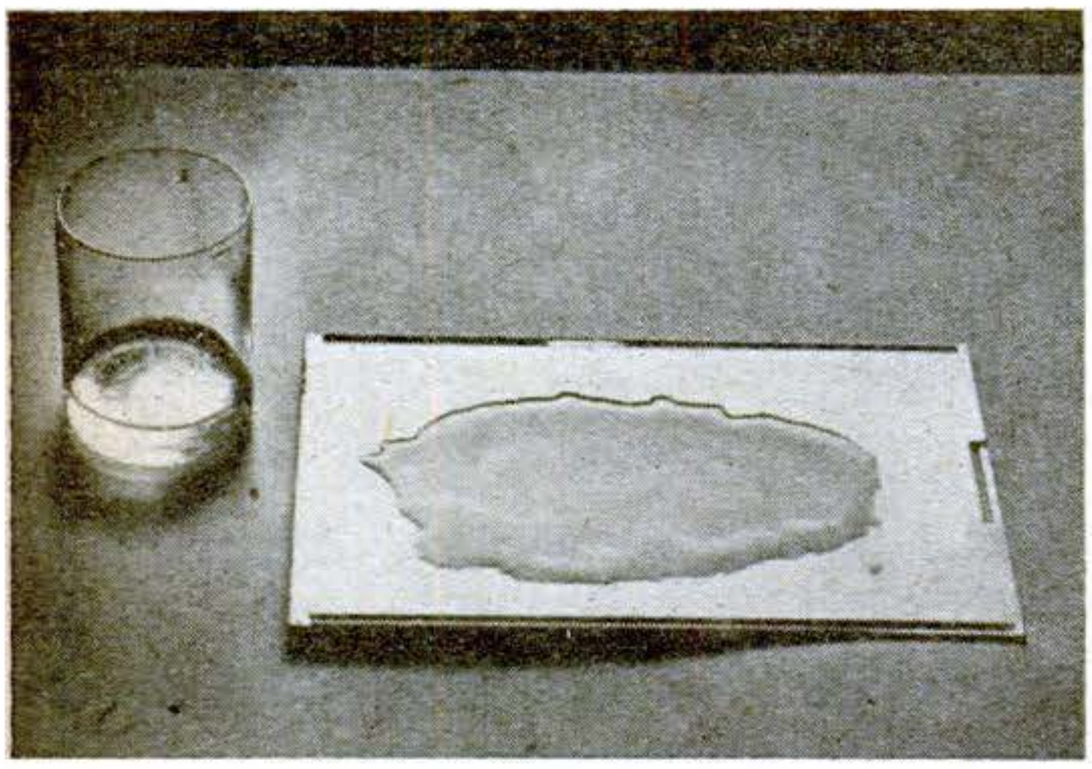
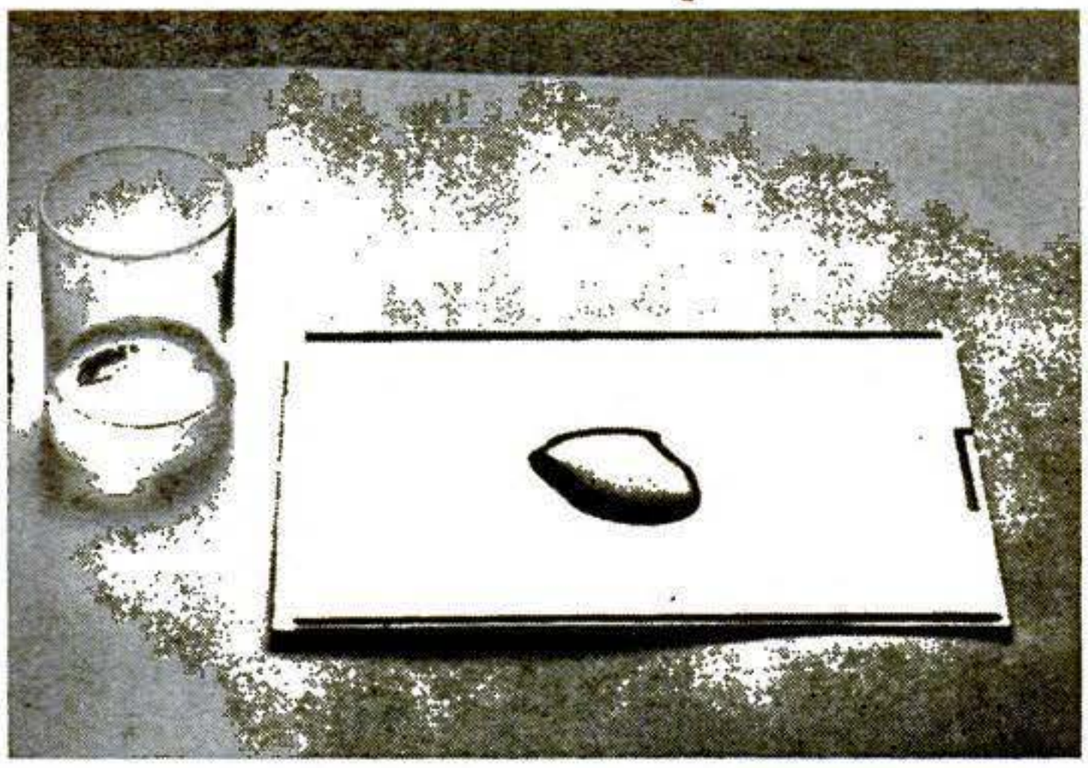
Experiments With Liquids Show Strength of Surface Tension

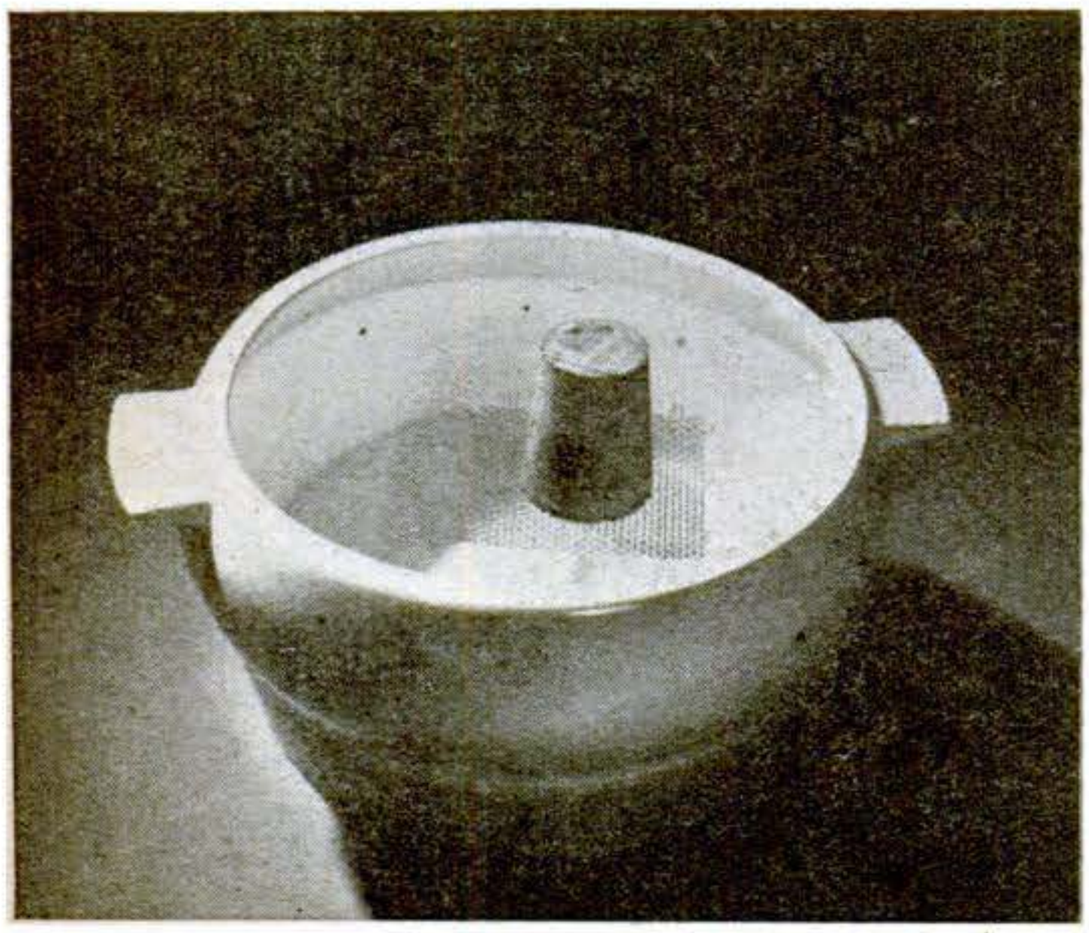
SURFACE tension of liquids has many surprising manifestations. Because of it, insects scurry over a pond with dry feet, a needle will float, and a glass can be heaped with water. This is brought about by the forces exerted by the liquid molecules. Inside a liquid mass, these forces are in equilibrium, since each molecule is entirely surrounded by others. But molecules at the surface have no companions on the outer side. Consequently, an unbalanced attraction draws them inward until an equal opposing force is set up. In effect, this inward pull produces a tough surface film.

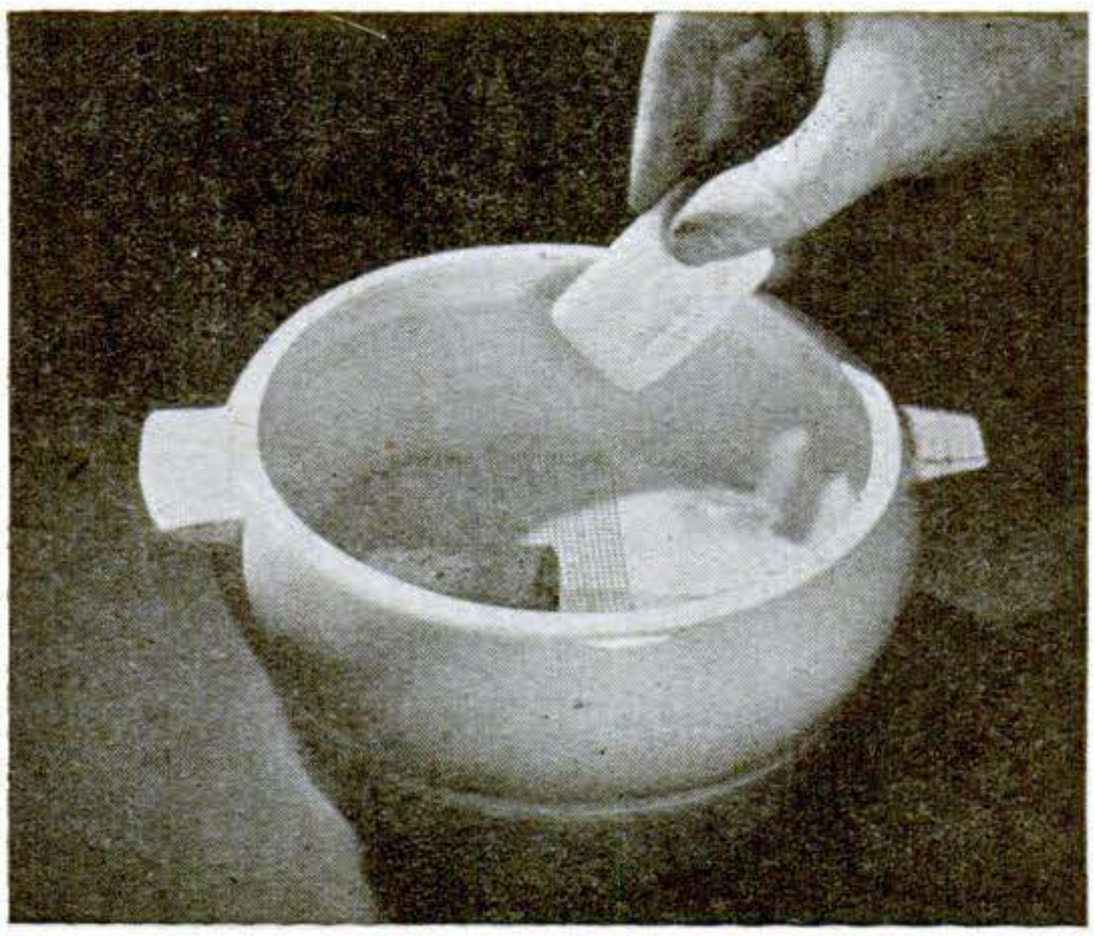




LIQUID SURFACES tend to contract until the inward pull upon the surface molecules is equalized. Because of this, water spread over any smooth surface that it does not wet will draw up into one or more rounded heaps. This tendency, however, can be overcome. Mix one part of denatured alcohol with three of water. This lowers the surface tension, and the mixture is easily spread over a smooth surface, as at the left. But as the alcohol evaporates, the liquid gradually contracts, as at the right.

OBJECTS THAT USUALLY SINK can be made to float if care is used not to break the surface tension. As a demonstration of this, coat a piece of window screening with oil, float it carefully on a bowl of water, then add a cork. You will observe that the screen depresses the surface of the water, yet does not go through it—an indication that surface tension acts like an elastic film. If you now wish to sink the screening, you can do so simply by lowering the surface tension. A little alcohol, ether, or liquid soap all will do it. Or if you merely touch the corner of a bar of ordinary soap to the water the screening will quickly sink to the bottom of the bowl.





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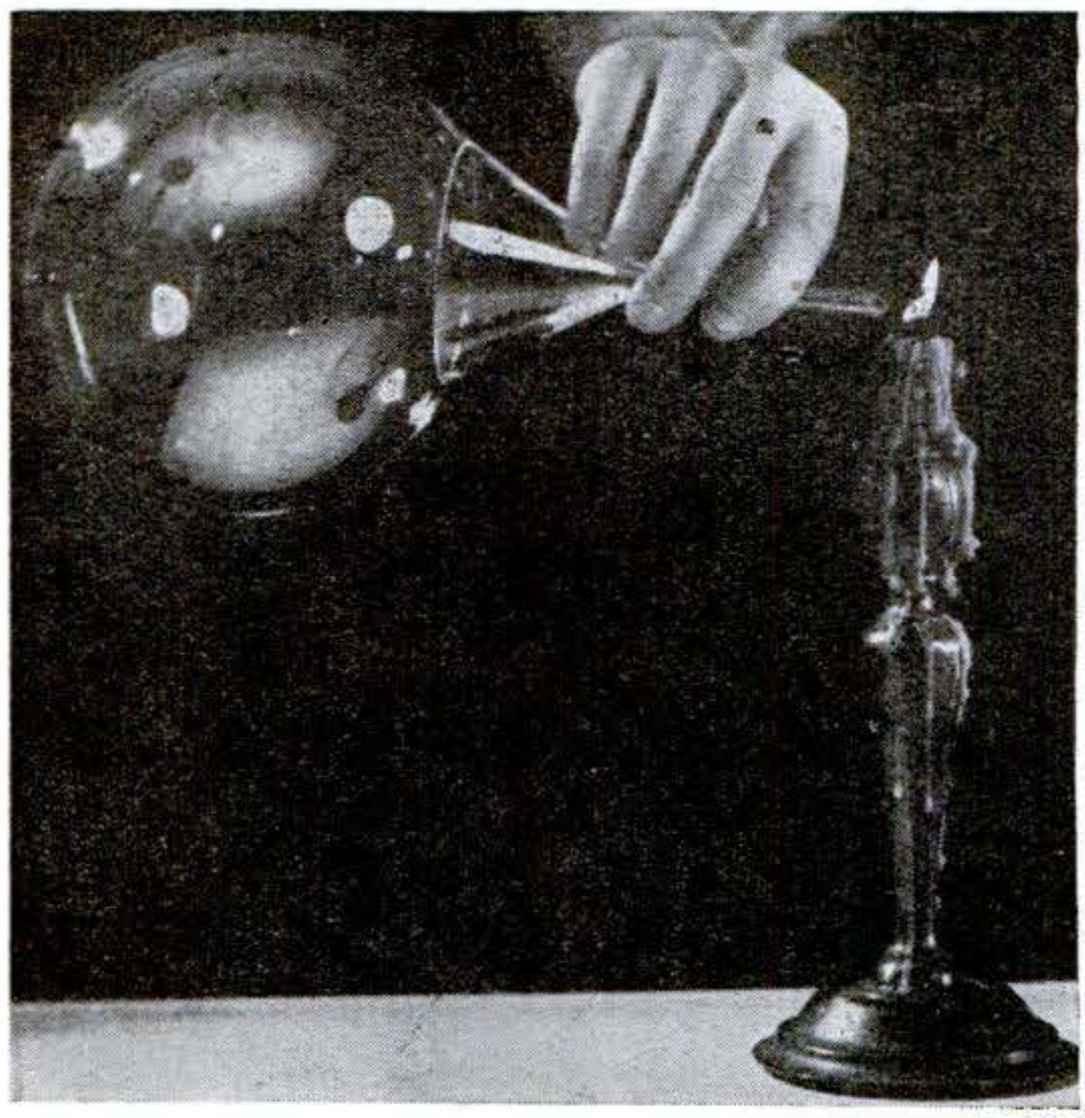
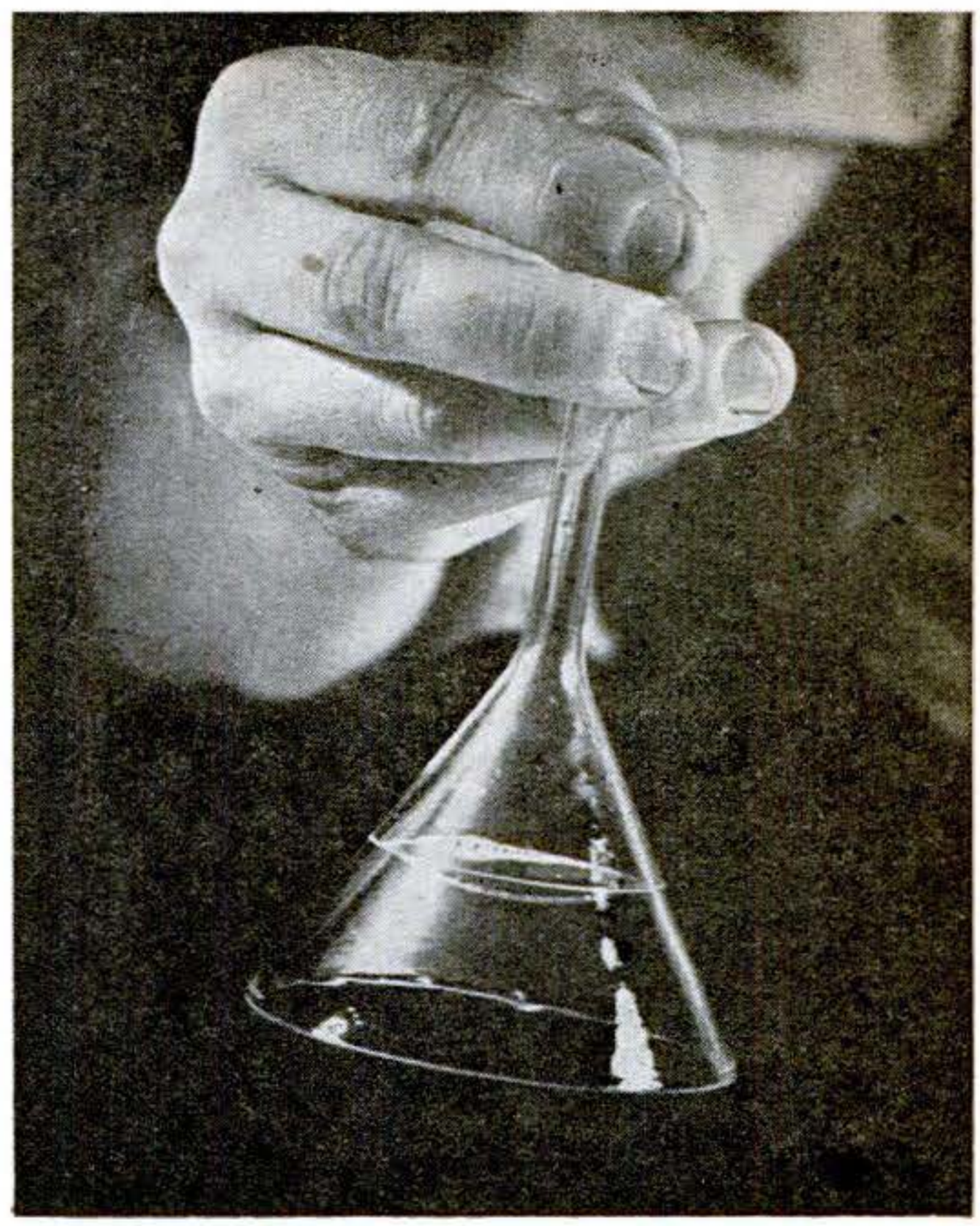
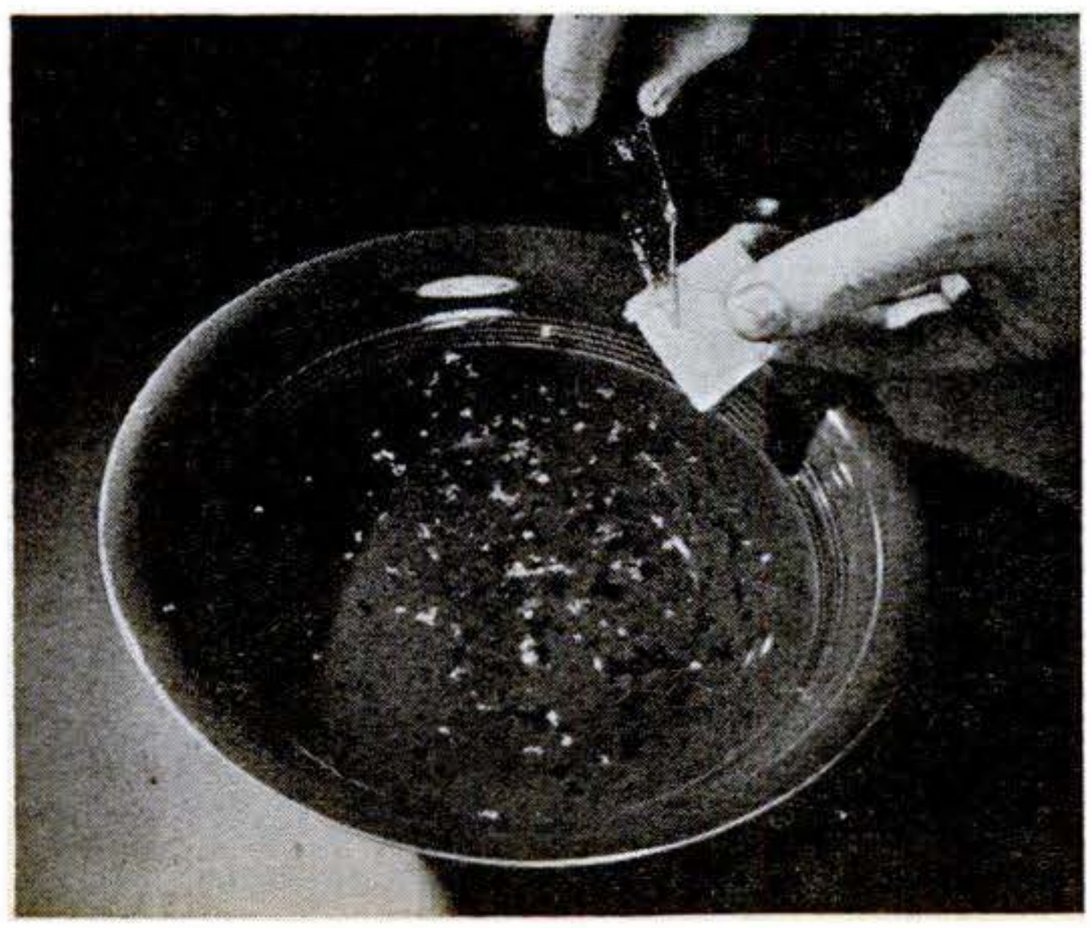
BUBBLE TENSION. Everyone knows what happens when a string is removed from the neck of an inflated toy balloon. But how many know that the fragile film of a soap bubble also is under tension sufficient to force air out of the bubble? As pictured below, you can show this by blowing a bubble with a small funnel and by then holding the stem near a candle flame. Air will blow the flame, and the bubble will contract until it bursts, surface tension causing the film to shrink to the smallest possible area.





FORM A SOAP FILM across the mouth of a funnel, and then hold the funnel with its mouth down and stem open. You might expect that gravity would cause the film to drop. Instead, it rises until it is high in the funnel. The contractive force of surface tension, seeking to make the film surface as small as possible, wins out over gravity.

OIL CALMS CRAZY CAMPHOR. Scrape several chips off a block of gum camphor and allow them to fall on the surface of clean water in a bowl that has been thoroughly washed with hot water and a soapless cleaner and then carefully rinsed. Immediately, the chips will begin darting crazily over the water, propelled by the differences in surface tension that are produced because the rough edges of the camphor dissolve at an uneven rate. Now touch the tip of a finger to the water. Unless you have washed your hands quite recently or have a dry skin, enough oil will flow from that single touch to cover the water and send the camphor scurrying to one side of the bowl.



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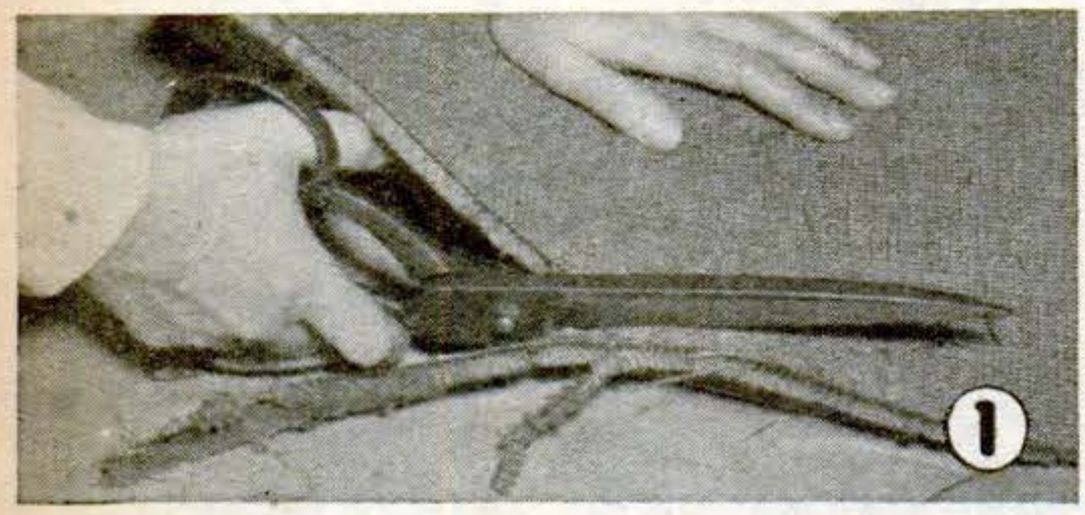
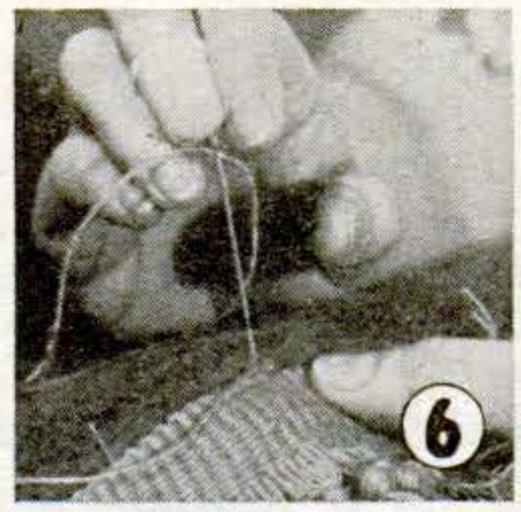
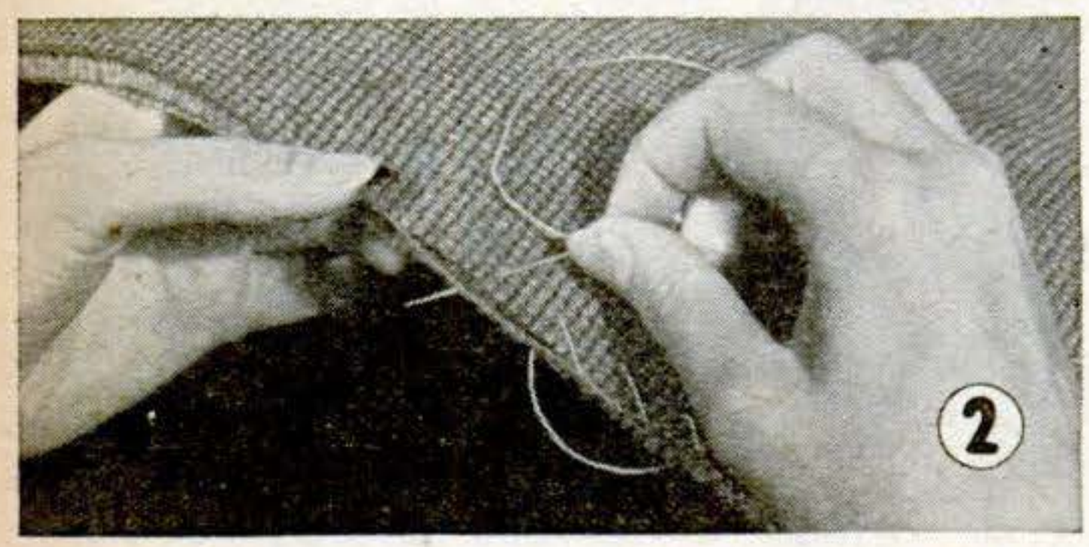
A STITCH IN TIME KEEPS A GOOD RUG DOWN

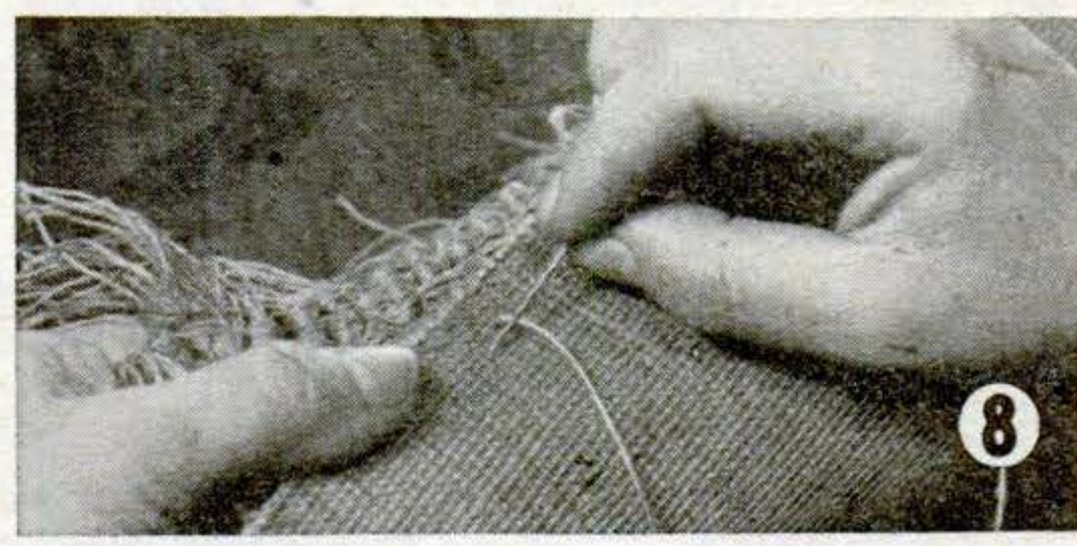
WHEN rugs and carpets wear badly or become torn or frayed under countless pounding feet, there's no need to assume they're past mending. Often, prompt repair will keep them in use for several additional years.

On these pages are pictures from a





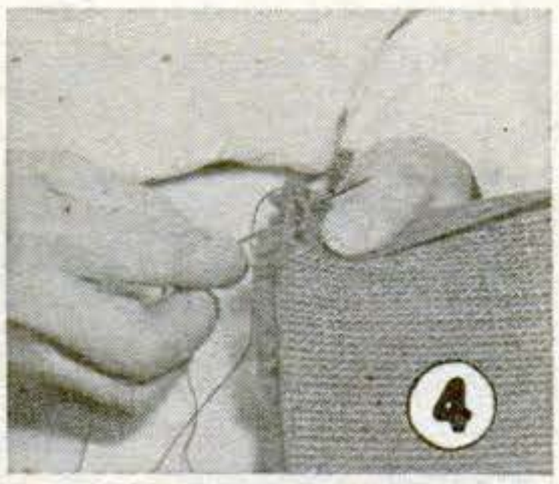


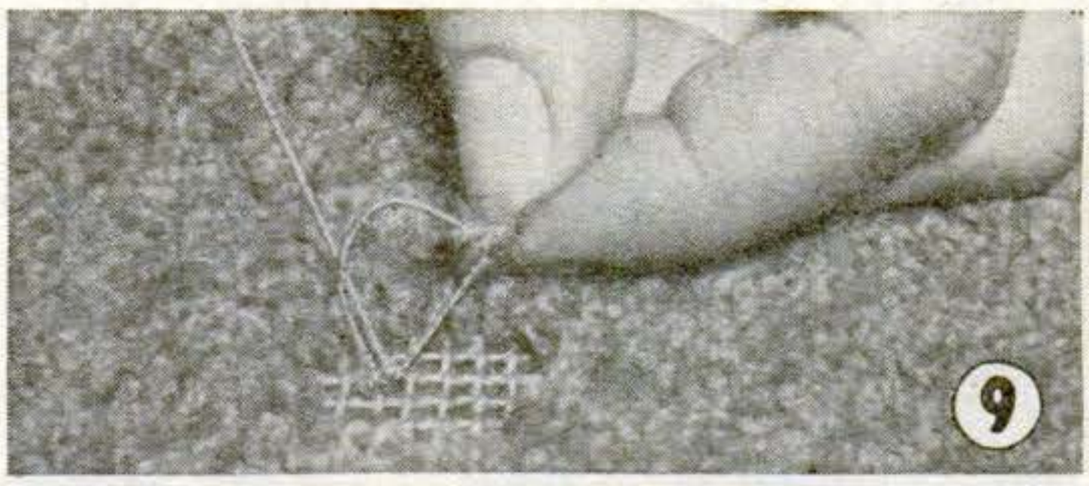


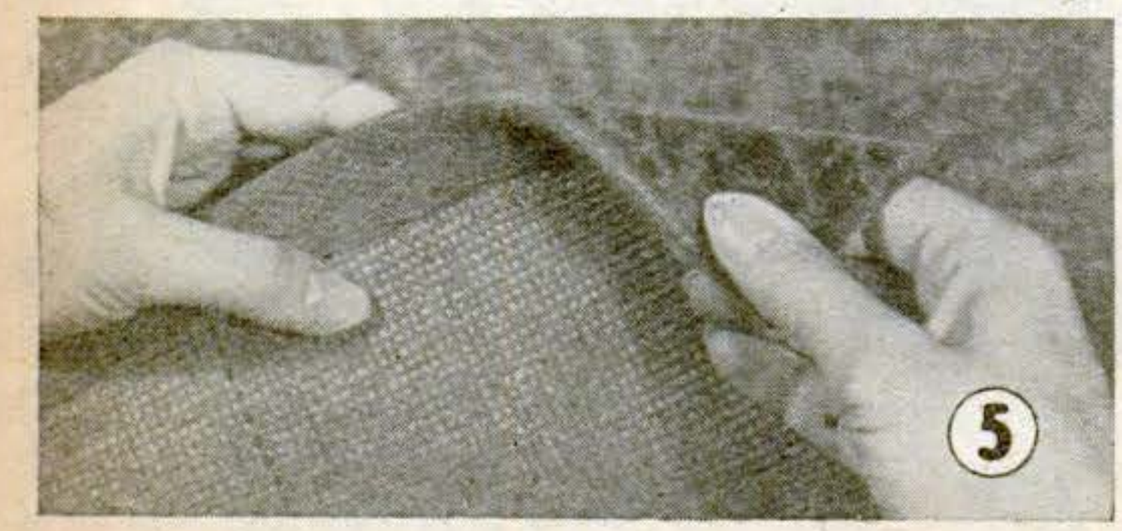
PILE RUGS AND CARPETS frayed at the edges should first be trimmed (1) from the wrong side with heavy shears. Begin where the fraying is deepest and follow one of the yarns or ridges to keep the new edge straight. After overcasting the edge with heavy thread (2) to make it stronger . . . . . you are ready to apply the binding (3). Guide it along the edge between the thumb and finger and sew with stitches ½" apart. At the end make two or three stitches backward, throw the last one over the needle, and draw the thread up tight. Fold in the corner (4) and stitch the binding to the wrong side of the rug. The finished repair job (5) shows a narrow strip of binding neatly stretched on the right side and a broader band folded beneath.

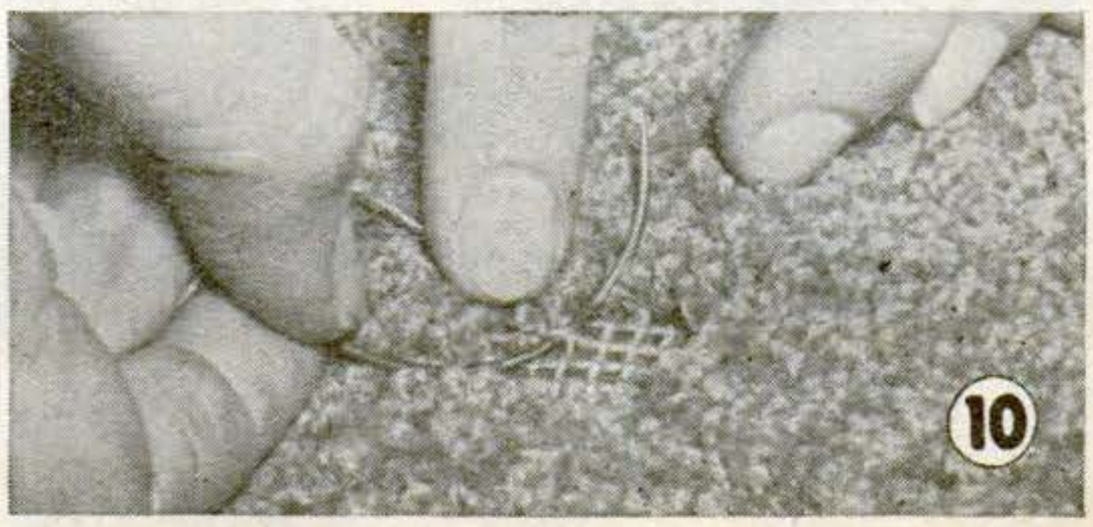
APPLY NEW FRINGES of the double type by pushing the trimmed edge of the rug between the two bands, pinning in place, and sewing with the stab stitch (6). Pin single-band fringe to the face of the rug (7) and sew (8) with a coarse darning needle and carpet thread that matches the fringe.

BARE SPOTS are frequently caused by burns, moths, or loosened ends of yarn. These may be repaired with tufts of material removed from a matching carpet, a curved upholstery needle, and carpet thread. Catch the needle in the foundation of the carpet (10) and make several stitches atop each other. But before pulling the last one tight put three or four tufts into the loop (9). Repeat until the bare spot in the rug has been covered.









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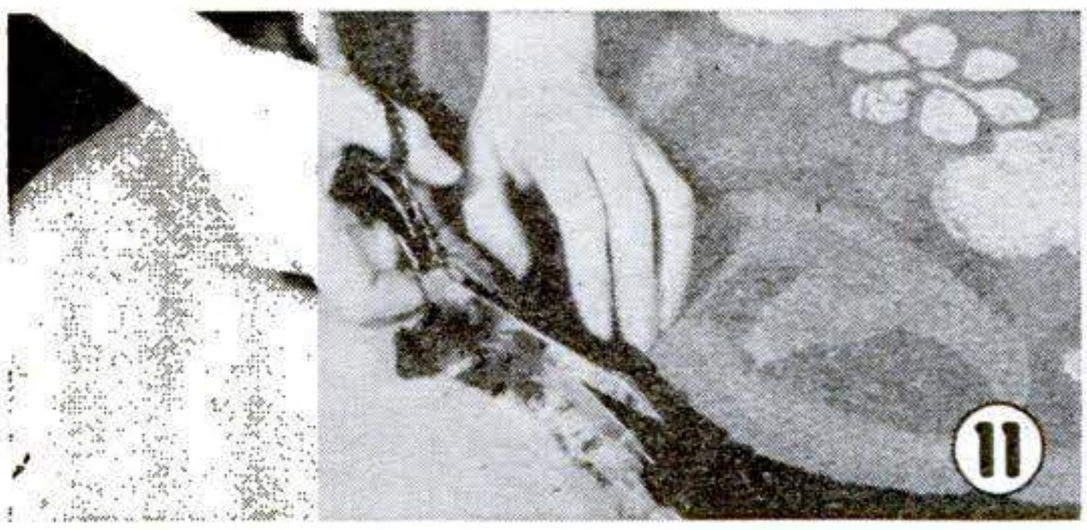
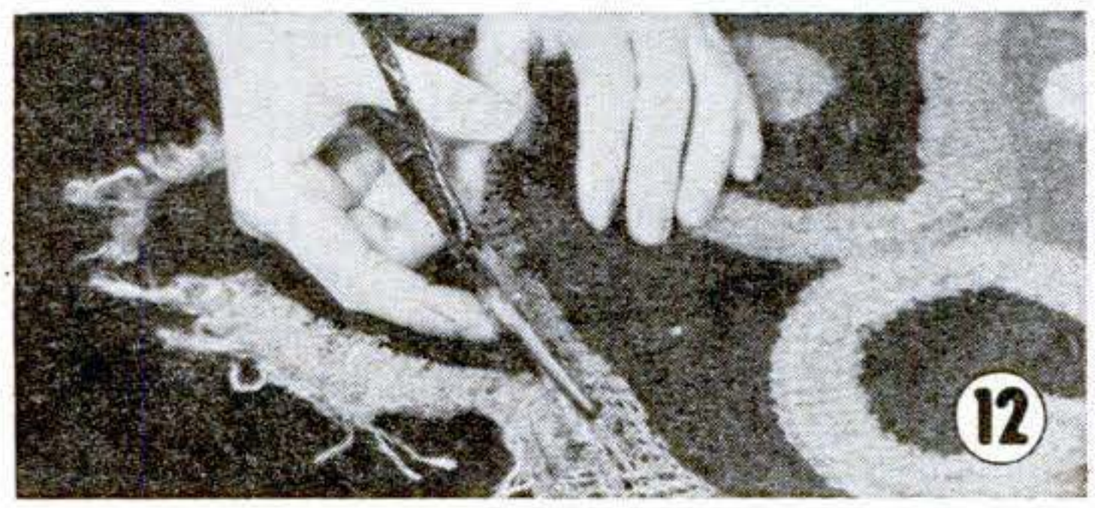
Department of Agriculture publication illustrating five of the simpler mending jobs that can be done at home on pile and hooked rugs and carpets. The procedures shown also may apply to less common repairs.

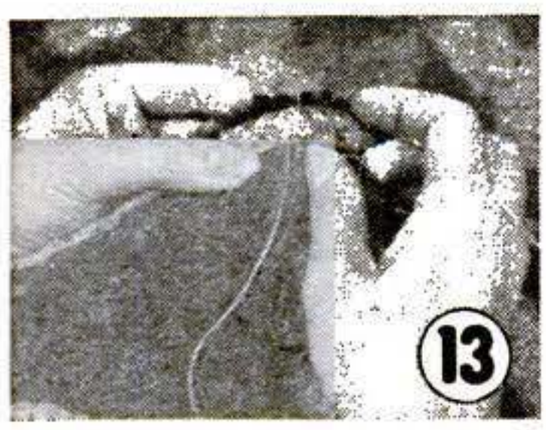
Equipment and materials should include strong shears, a darning needle 2½" to 3" long, embroidery or large-eyed sewing needles, a curved upholstery needle for burling bare spots, a crochet hook, a thimble, linen thread, twilled carpet binding about 1½" wide in a color to match the rug to be repaired, fringe, carpet yarn, facings, linings, and patches.—A. R. B.

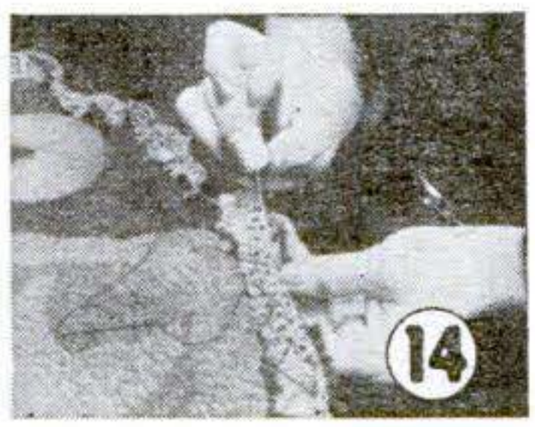


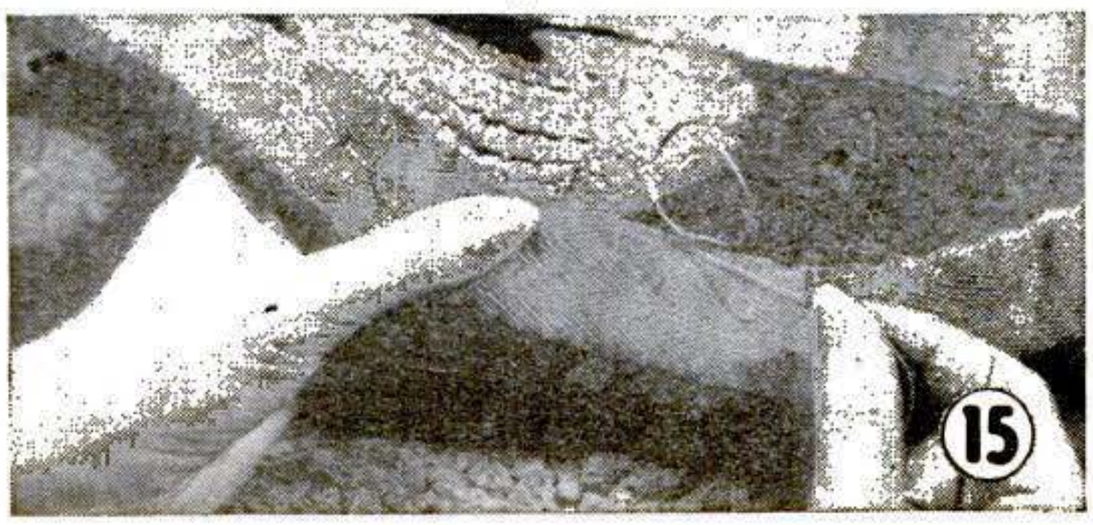


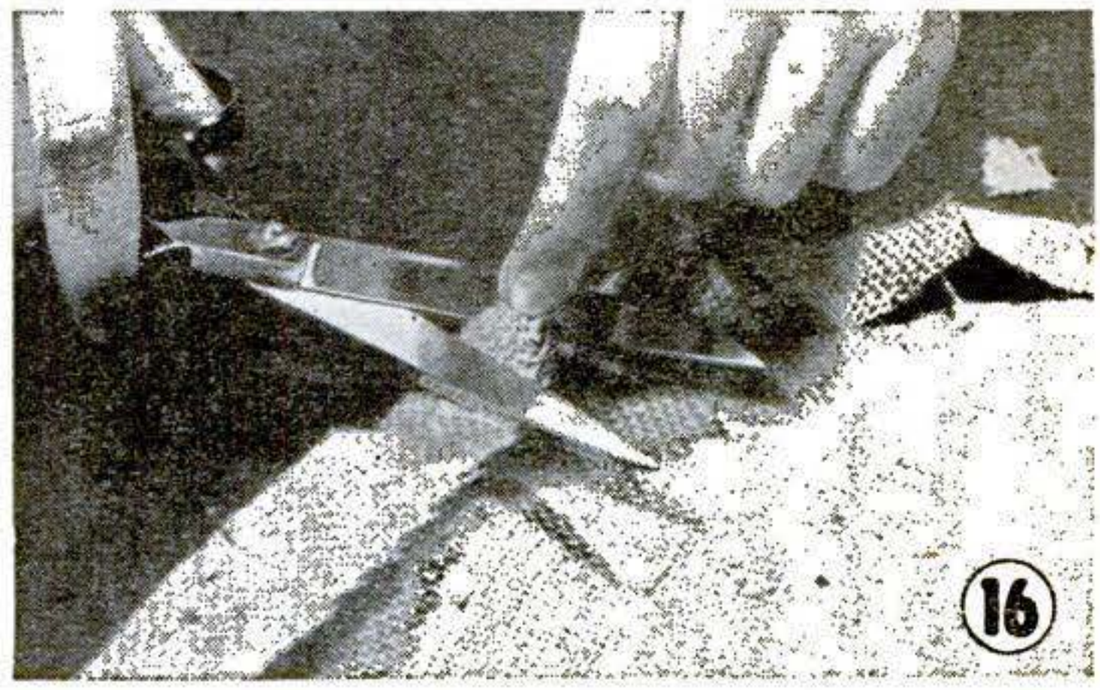
WHEN EDGES FRAY on hooked rugs, rip out the hem (11) and draw a line parallel to the edge on the underside, starting about 1" back from the point of deepest damage. Then, with a darning needle, pull out all loops back to this line. Trim away the rough edge (12), leaving 1" of burlap . . .

. . . If this material is strong, you need only turn under the raw edge, pin, and hem (13) to the rug foundation. But if the material is weak, the edge should be turned back and sewed to the body of the rug with a catch stitch (14). Then sew on a strip of carpet binding (15), catching only a few yarns of the background fabric and about ⅛" of facing. Run a gathering thread along the inner edge of the binding on oval or round rugs to ease in fullness.



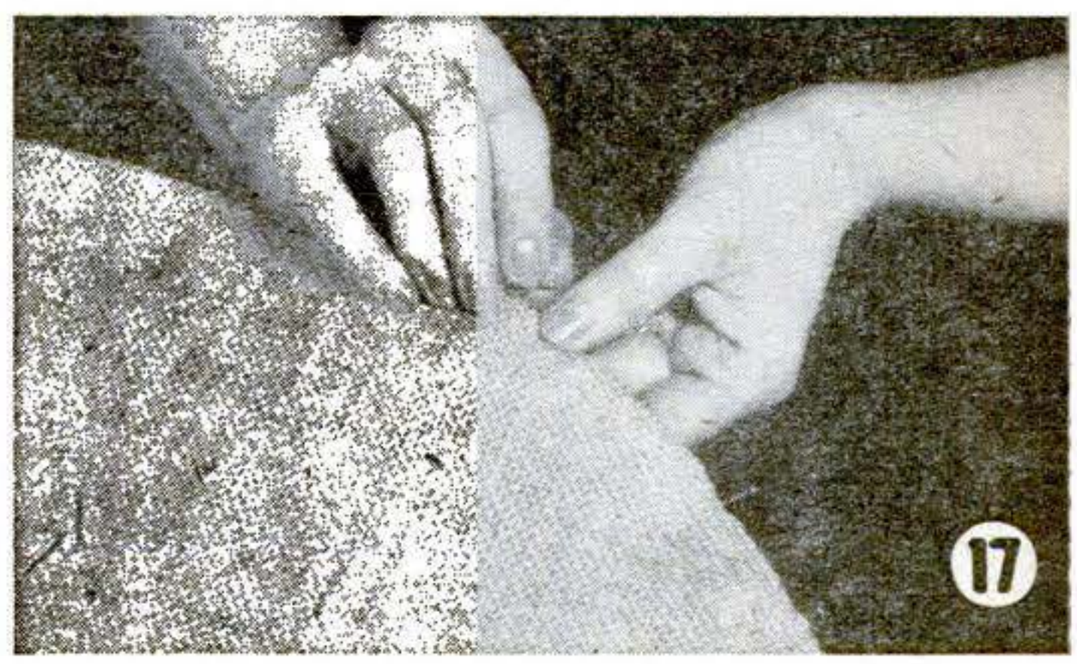


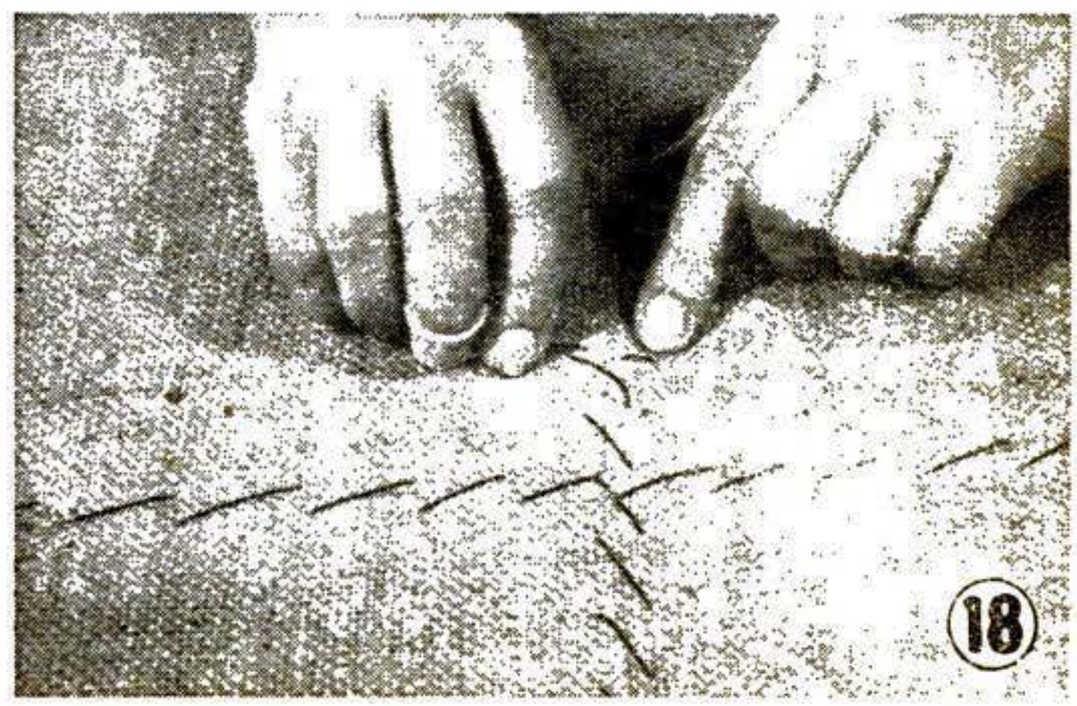




NEW LININGS must be cut a bit larger than the rug they are to fit. After preparing the edge as if for a new facing (11 to 14), turn over the lining and pin it fast. On round rugs, cut notches at intervals (16) so the lining will lie flat . . .

. . . With the lining securely pinned and basted to the wrong side of the rug (17), sew it around the entire edge by overcasting with heavy thread. Then about every 6" catch the lining to the back of the rug with a series of tailor's bastings (18). This keeps the lining in place and helps to strengthen the body of the rug. If there are any weak places in the foundation material, darn the lining to the back of the rug there in order to lessen strain.





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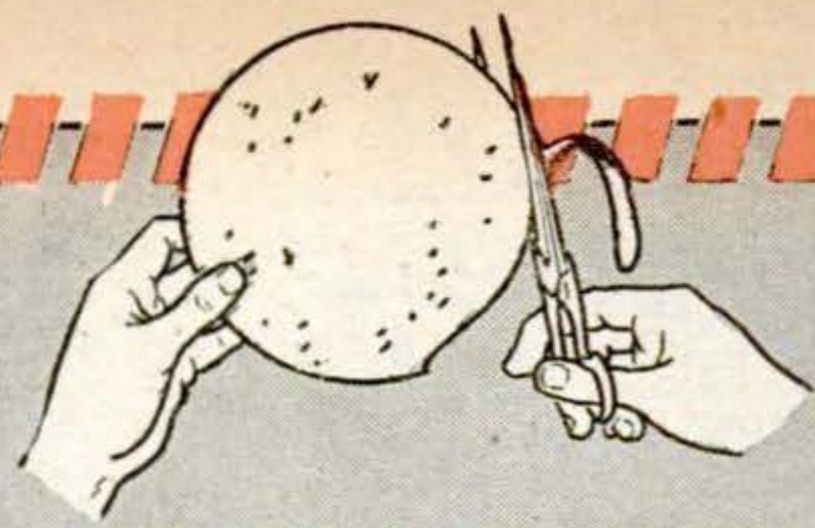
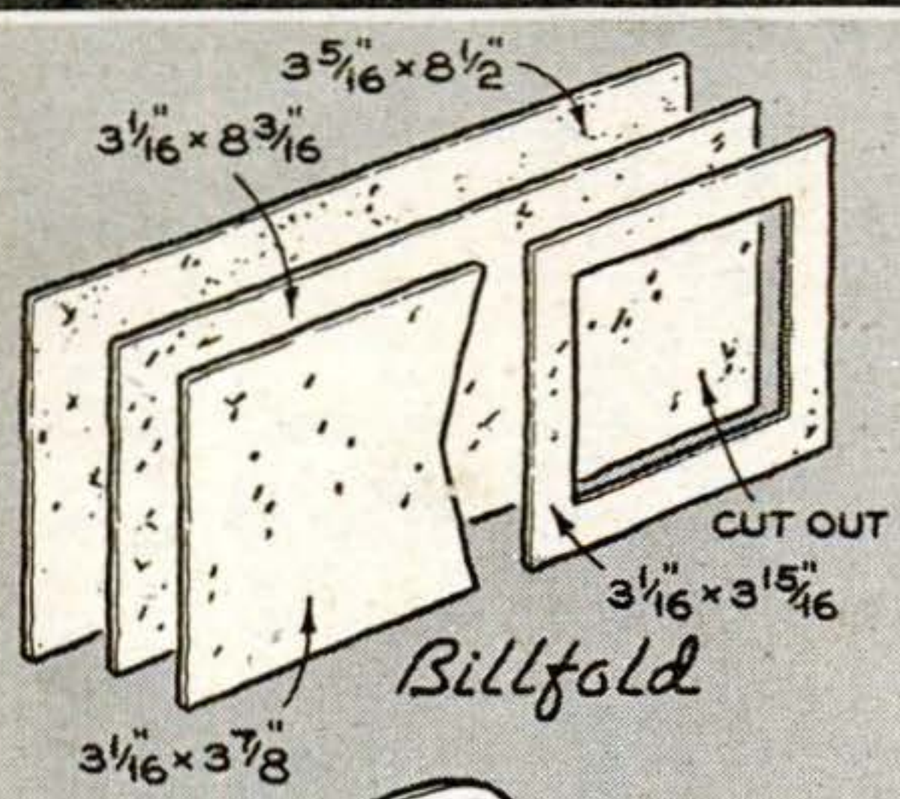


LEATHERCRAFT PROJECTS *with a personal touch*

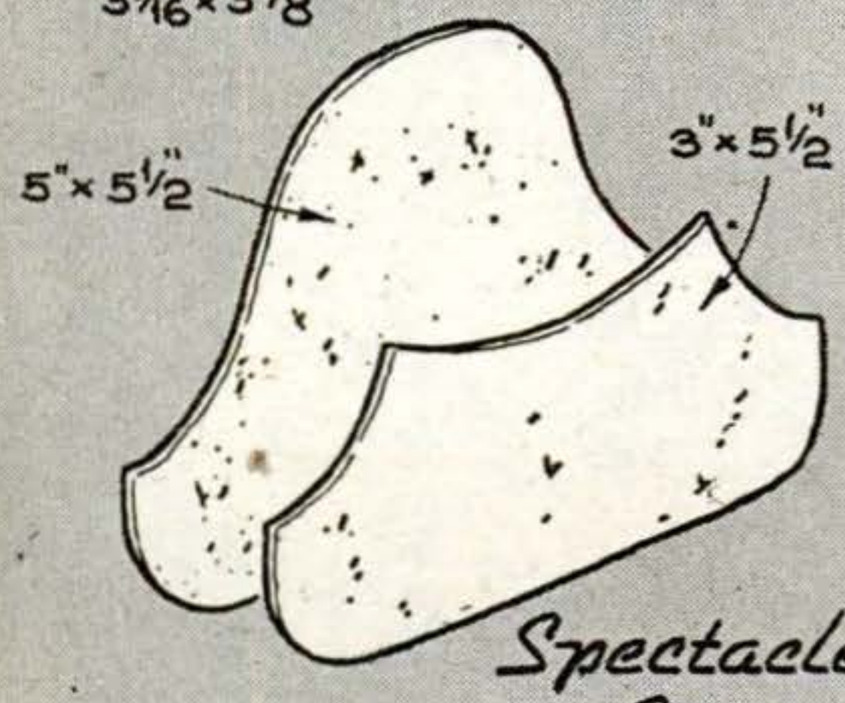
ONE OR TWO handbags, discarded by the lady of the house as no longer fit for use, will provide all the leather required for these simple articles. Smart results can be produced by combining leathers of different color and texture from separate bags.

After the leather pieces are cut to the size and shape indicated in the drawings, the next step is to punch the lacing holes, aligning them 1/16" to ¼" from the edge at intervals of about 1/16". If a leather punch is not available, the holes can be made by driving a properly shaped ice pick or nail through the leather into a block of soft wood. Holes in pieces which are to be laced together must be carefully matched or the leather will pucker. Lacing about ⅛" wide may be cut as indicated in the drawing at the top of the page and spliced as shown below. Clamp the ends together until the rubber cement dries. Two simple stitches also are shown below.

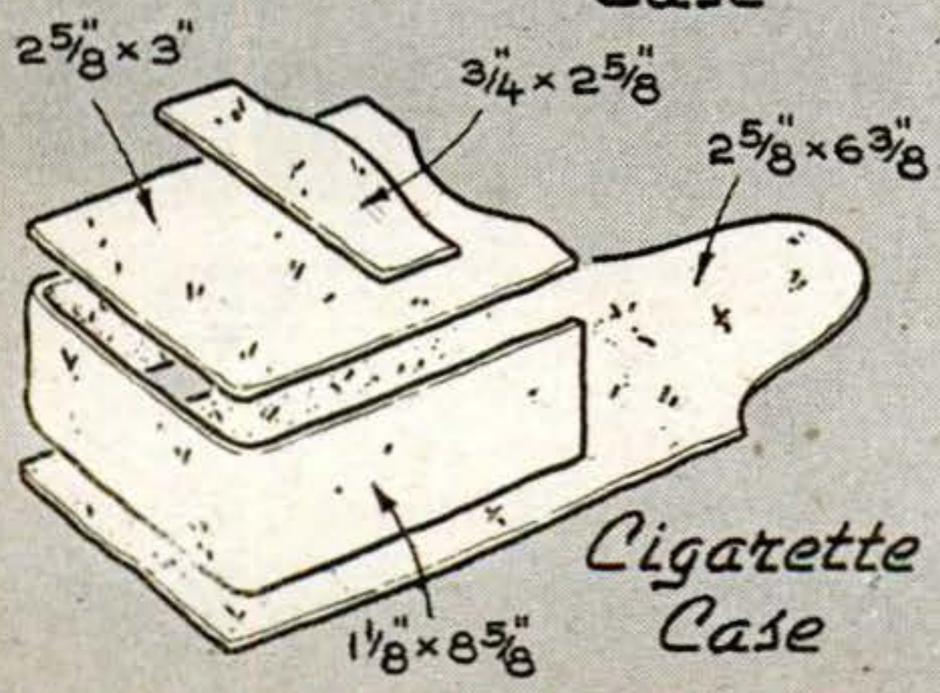
Saddle soap rubbed on the leather will improve the appearance of the finished articles.—JACK AND JAN HOLMES.



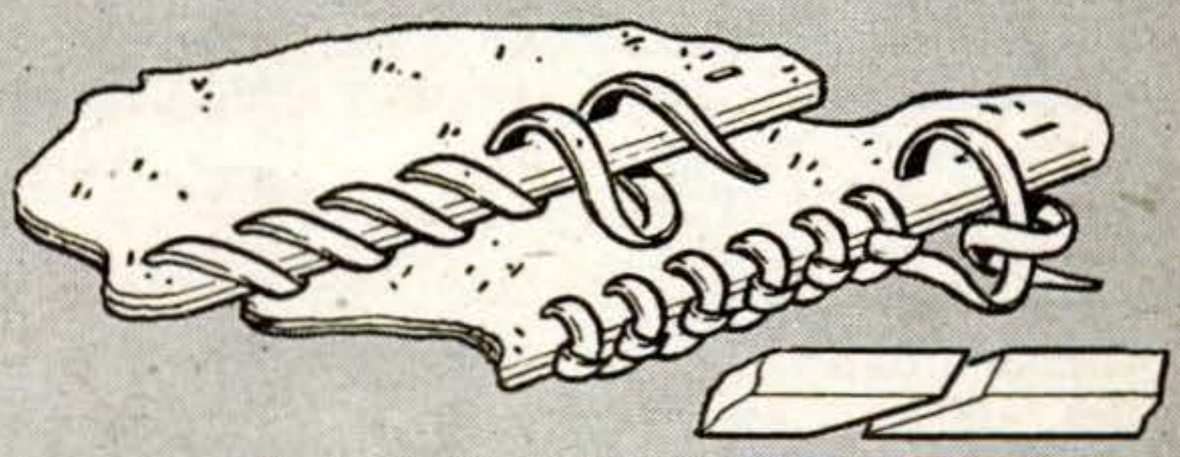
Billfold



Spectacle Case



Cigarette Case

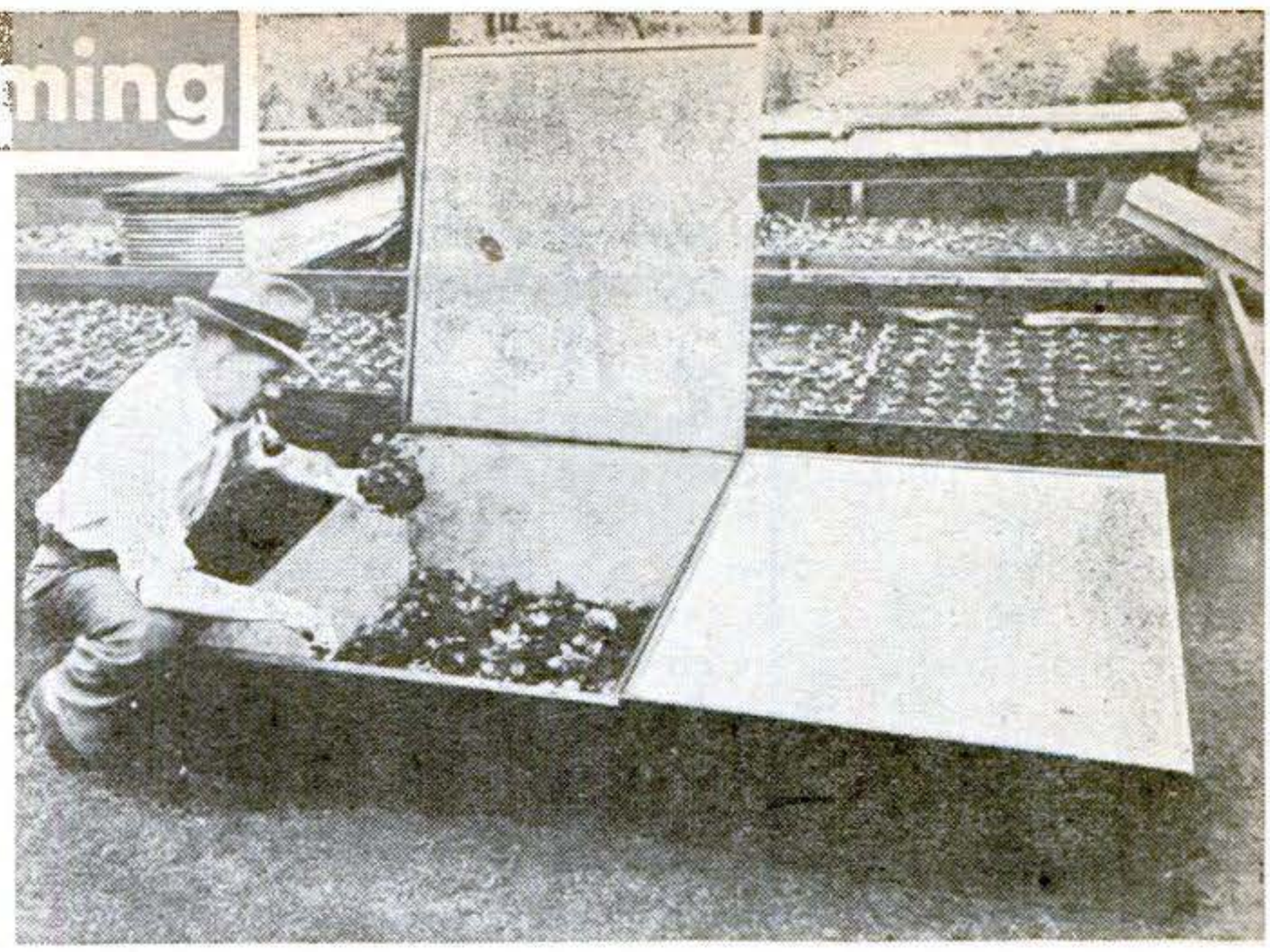


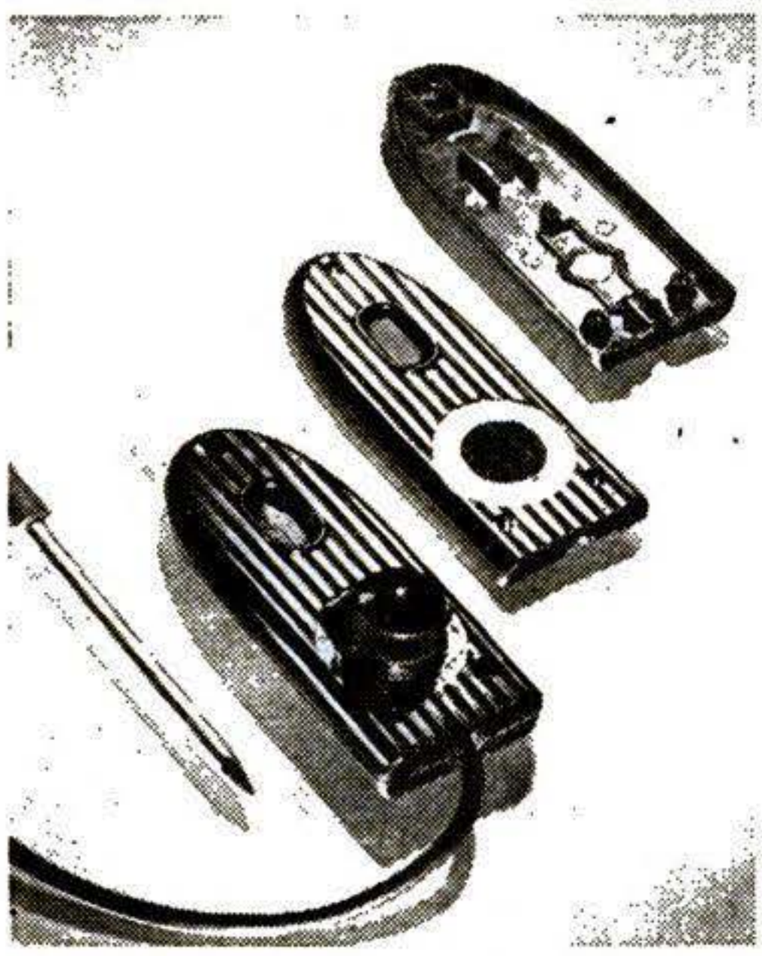
Types of Stitches

USE RUBBER CEMENT TO SPLICE LACING

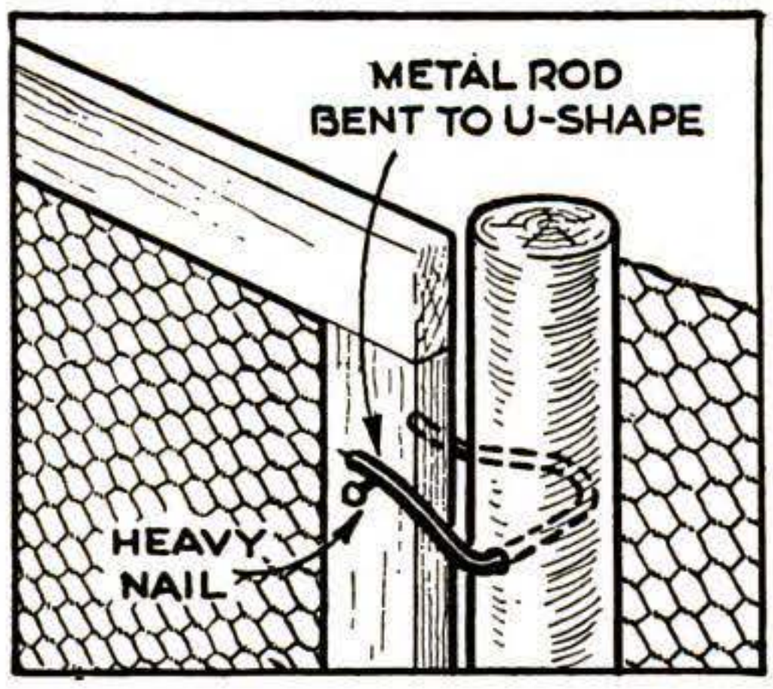
For Easier Farming

VOLTAGE CHECKS on electric fences are made quickly with a pocket-size tester employing a neon indicator. Housed in Tenite, the device is marketed by the Electronic Specialties Company, of Chicago. With a range from 100 to 600 volts, it can be used also for tractor and auto-ignition and power-line tests. It works on the spark-gap principle.



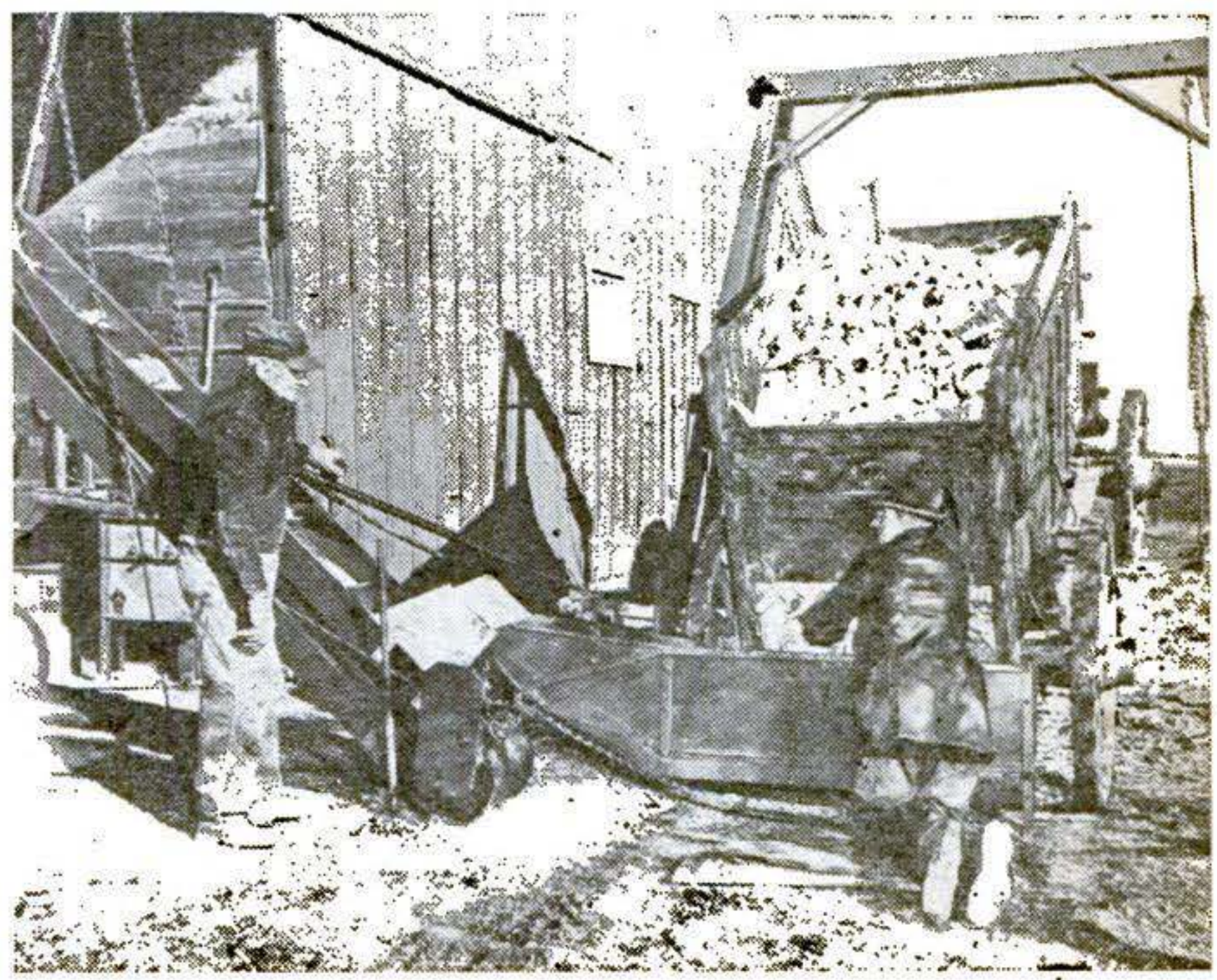


TRANSPARENT-PLASTIC PANES, used instead of glass, admit ultraviolet and infrared rays along with sunlight to a new, compact cold frame. The material in the panes is wire-reinforced Vimlite, a product of the Celanese Corporation of America, and is said to be hailproof and shatterproof as well as an insulating substance. On the cold-frame unit shown above are two 36″ panes. Such frames are suitable for preliminary rooting of fall-planted bulbs to be potted for indoor blooming.



A GATE LATCH that can be opened or closed from either side may be made from a single 2′ length of old auto brake rod, small pipe, or extra-heavy wire. Bore a hole through the fence post for a snug fit, push the rod through until it is centered, and bend both ends to a U-shape, as shown in the drawing above. Work it several times until it moves easily. A nail in the gate serves as a stop to keep the latch from dropping.—J. W. CAMPBELL.

WITH A MOVABLE GRAIN ELEVATOR built of spare parts at a cost of $75, Wesley Jones, a farmer near Moline, Ill., gets his corn and other grain crops stored quickly at harvest time. Jones built the machine when he was unable to purchase one, finding most of the parts he needed among spares for machines he already owned. He mounted the elevator on two wheels and balanced it for easy transfer around the farm. Jones is shown at left below operating the machine as a helper directs corn into it from a hoisted farm wagon.



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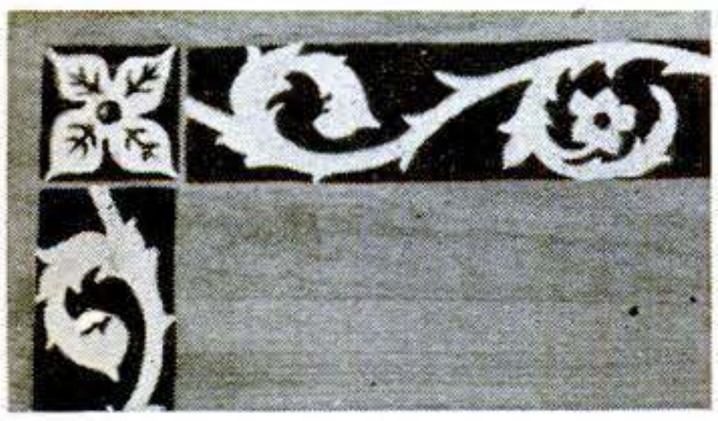
PAINT A CARPET ON YOUR FLOOR

OLD floors, beyond hope of redemption with varnish and wax, need not make the home owner despair. Minor miracles can be worked with the judicious use of good floor enamels. Stenciled borders or over-all designs may even make carpets unnecessary in some cases. The stencils are available at paint shops in great variety, ranging from modern designs to Colonial and peasant-style motifs that go well with hooked or rag rugs now so popular in many homes.

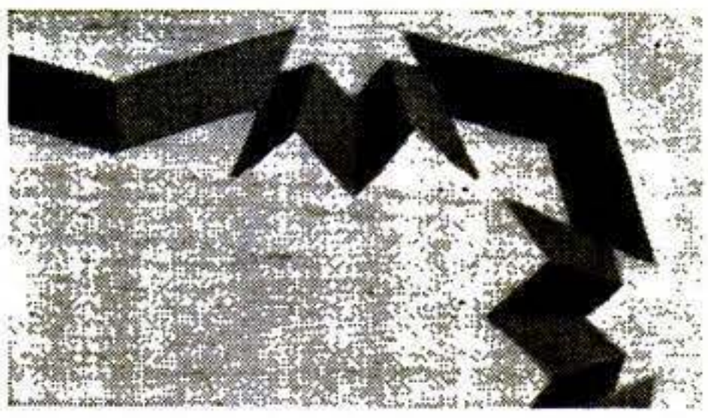
Be sure that the floor is thoroughly clean, wiping it thoroughly with naphtha, benzine, or white gasoline to remove all traces of old wax or oils. These solvents are inflammable and their fumes can be dangerous, so take care not to have a flame in the room while using them, and open all windows for good ventilation. Then wash the solvent off with water and a good soap powder. When the wood has dried, scrape out all cracks and fill with a floor crack filler or a putty made with floor varnish. Set protruding nailheads and fill in over them.

Use only good-quality floor enamel, for it will have to stand much wear. If the floor has never been painted before, start with a white-lead primer and cover this with two coats of floor enamel of the desired color. Floors that have been painted before need no primer. After applying the stencil pattern or border, finish with a protective coat of clear varnish or wax, which can be renewed from time to time without repainting the design.

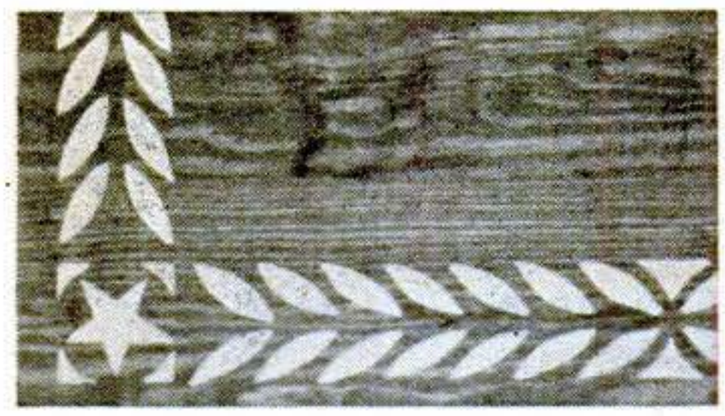
For the design, you may want to lighten or darken some of the commercial enamels with white lead or lampblack, or to brighten them with oil colors, but avoid



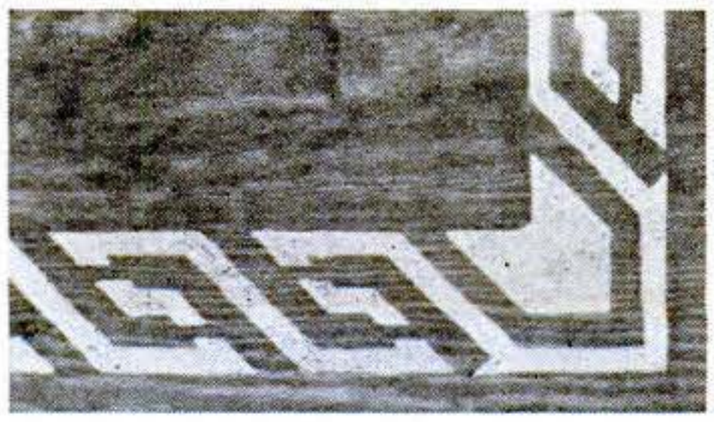
Stencil brushes, above, come from ¼" to 3" in diameter. Left, a typical border in a peasant motif, used on pine.



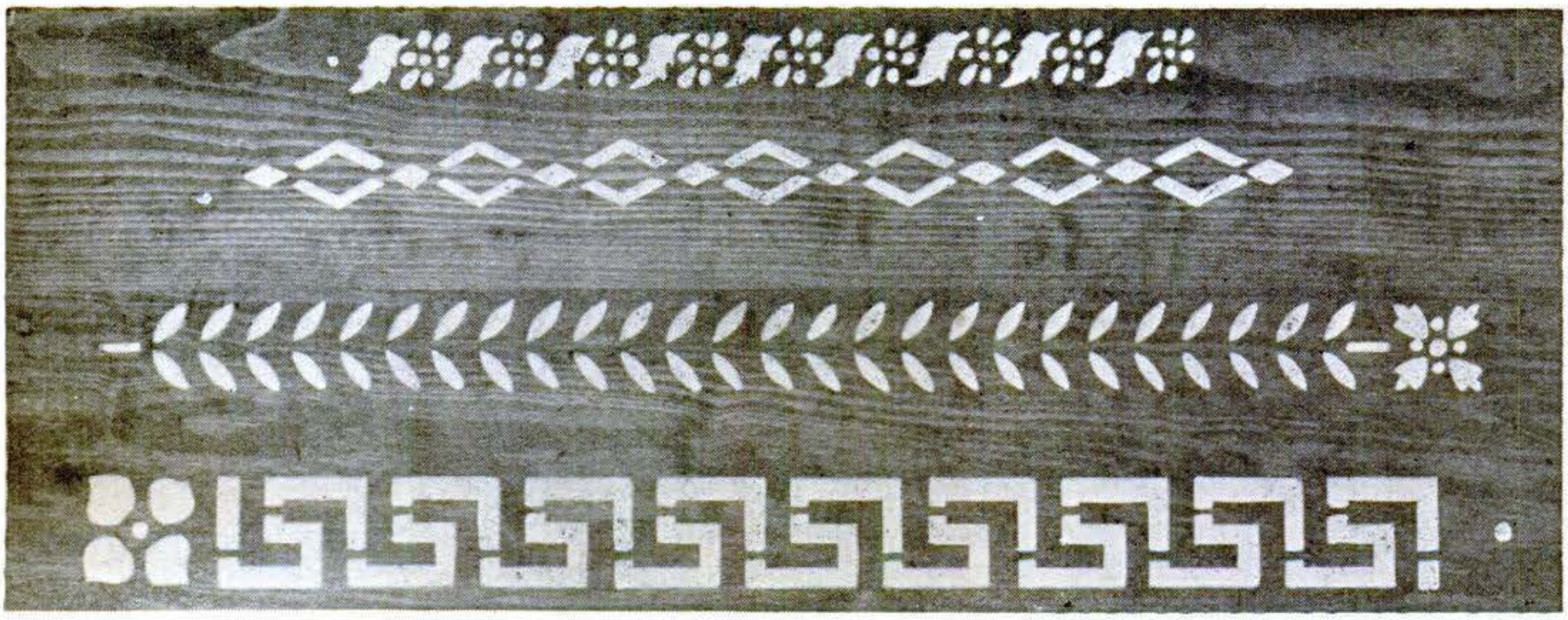
Modernistic in design, this stencil was used in red and black on a natural-oak base. Each color had its stencil.



This Early American pattern was used on a stained floor of yellow pine. Note how the leaves change direction.



One variation of the classic Greek fret or key design. It was applied in cream enamel on yellow pine stained brown.



Four band designs suitable for light or dark floor borders. Some stencils have special patterns for the corners; others can be turned by covering the stencil at a corner with cardboard at a 45-deg. angle.

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Over-all or diaper stencils are made with the cutout duplicated several times to save work in shifting. The paint is applied by pounding down with the brush.

adding linseeed oil, for that may make enamel run in a stencil. If more liquid is needed, use first-grade floor varnish.

Select a stencil brush of the largest size that can be used with the stencil, and do not overload it. Dip the brush into the enamel and wipe off as much as possible on the side of the can; then stamp out more of the liquid on a board or a newspaper pad. When the brush seems about empty, it will probably be just right for use. As more color is needed, take it from the pad or dip only the tip in the can. Stencil brushes are pounded on the design, not stroked.

Locations for designs may be marked with chalk or a pencil. Hold the stencil down with adhesive tape. When moving it to another section, just wipe the paint off the back with benzine or turpentine. Start a diaper or over-all pattern in the center of the floor and work outward. This will equalize the amount the room may be out of square. Borders may be started in a corner. To turn corners, use either a special corner pattern, or mask part of the stencil with cardboard.—F. N. VANDERWALKER.

Here the same design covers all squares with black and white alternating on a brick-red enamel base.

KITCHEN ENGINEERING

As a supplement to air conditioning, a new plastic fan, built like a turbine, keeps the kitchen cool—and won't bite.

At left, the concentric rings set in the ceiling are a pair of sterilizing lamps that annihilate germs instantly and give the kitchen laboratory-like cleanliness.

Ice cubes, ready to use, come bounding from a dispenser automatically at the press of a trigger. The refrigerator is horizontal with wide work space on top.

DINNER is bound to be good if it's prepared in a modern kitchen like this one shown in a new POPULAR SCIENCE ON THE SCREEN release produced by Jerry Fairbanks in co-operation with this magazine. Science has made this important room in the house a real culinary laboratory. There are twin ovens—one a rotisserie and the other for straight baking—that are thermostatically controlled, have transparent doors for watching the progress of the cooking, and utilize clock control that shuts off the heat when the roast or cake is done. Grills and hot plates work on the same principle, taking the guesswork out of the art of cooking.

The refrigerator is of horizontal design, providing work space when needed and keeping its contents in easy reach. In the frozen-food compartment, slip covers protect the flavor of vegetables and meats even when they are stored for weeks. As for ice cubes—just press a trigger and they come bouncing out ready to use.

Then there is a sterilizing lamp. It's a ceiling fixture that brings quick death to airborne germs.

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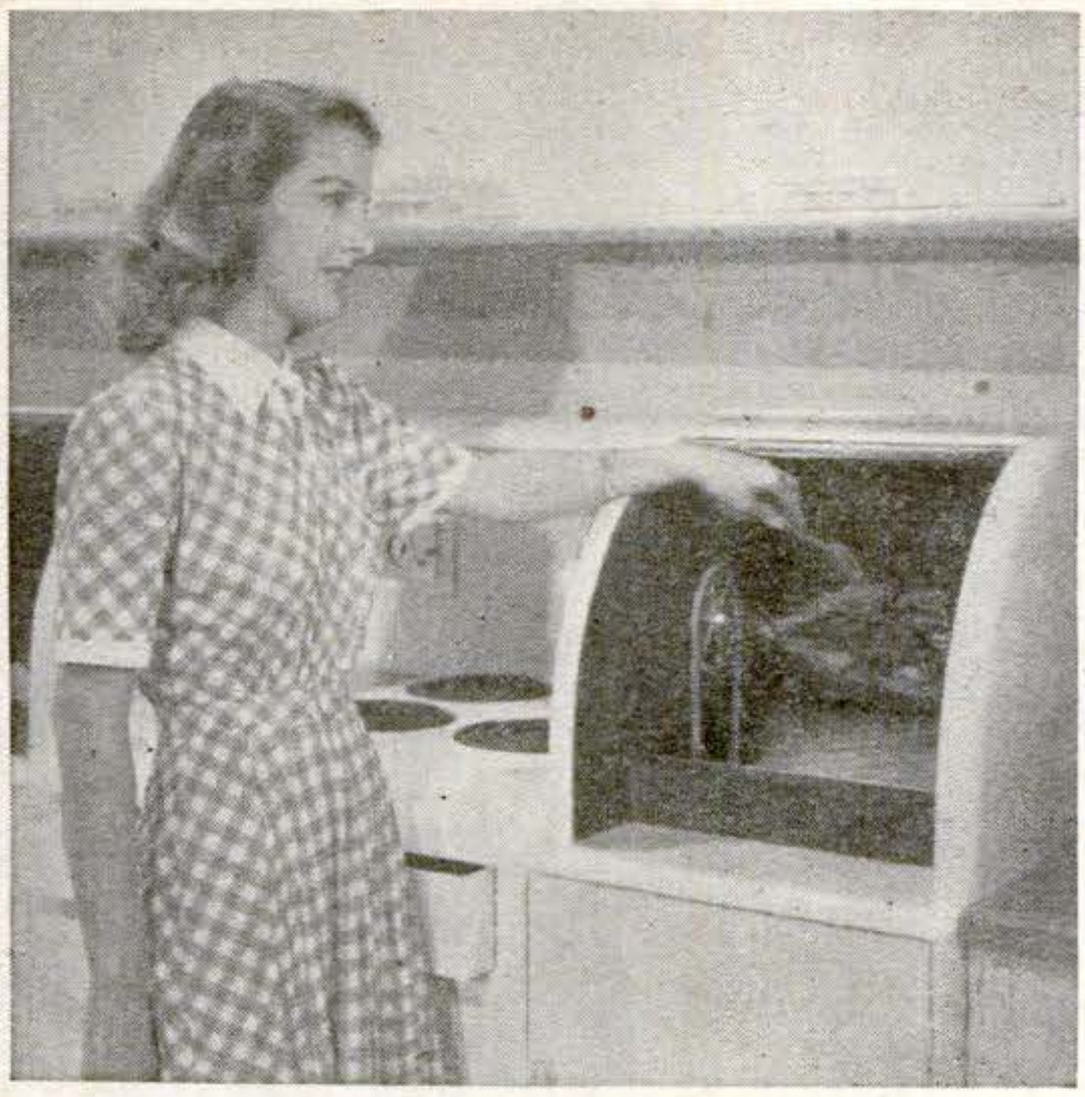
MAKES COOKERY EASY



Twin ovens, at waist height on either side of the range, are thermostatically and clock controlled. Transparent doors permit watching the progress of the cooking without disturbing the cake or roast. Grills and hot plates also have foolproof controls.

Revolving shelves in the cabinet shown above put pots and pans where they can be reached without fumbling. All cabinet doors, overhead as well as below, are designed to slide instead of swing, a simple remedy that prevents bumping and tripping.

When the meal is done, a completely preset table glides out of its hiding place, and dinner is ready to be served. No, sorry, the table doesn't set itself; that must be done by hand in the old-fashioned way.

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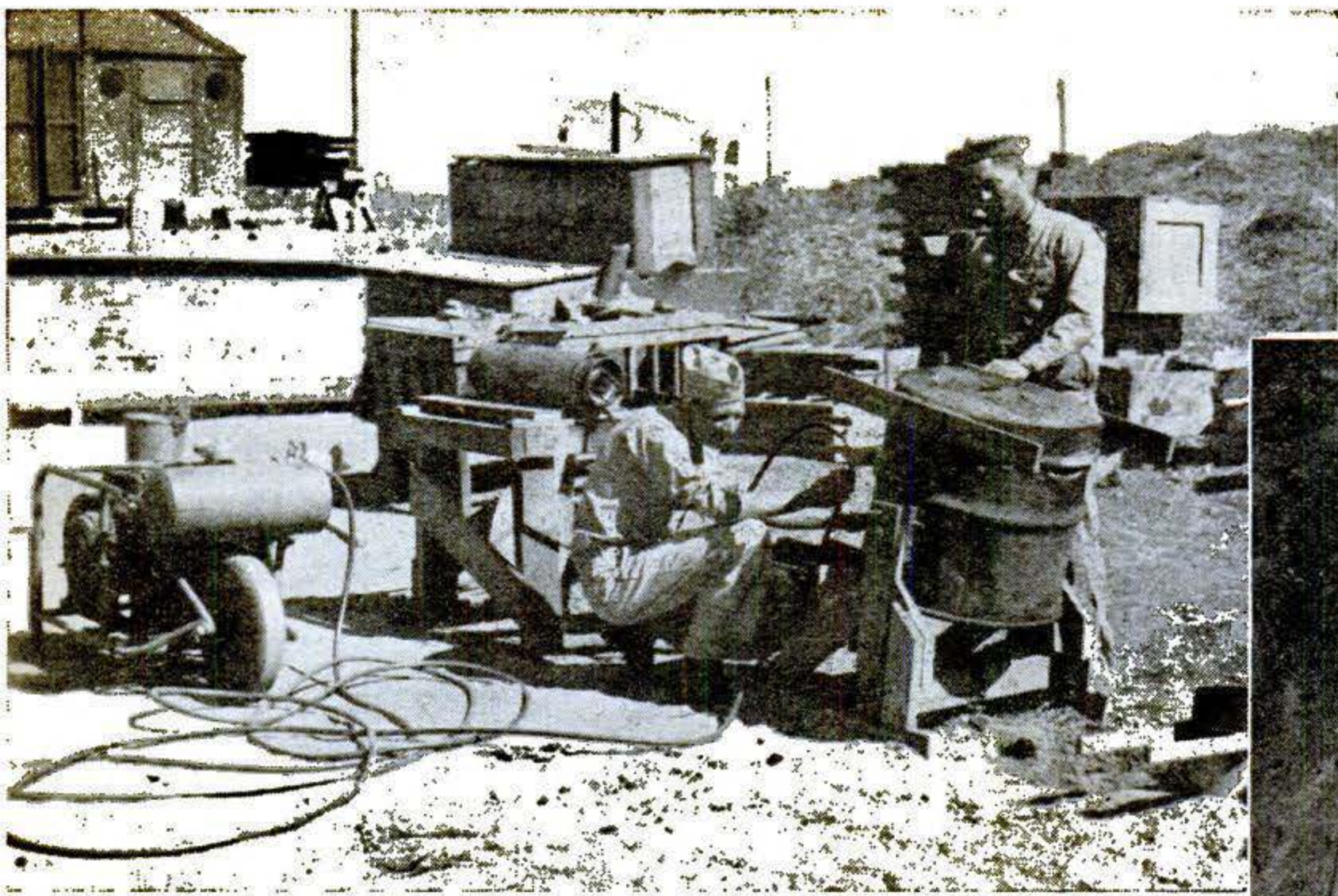
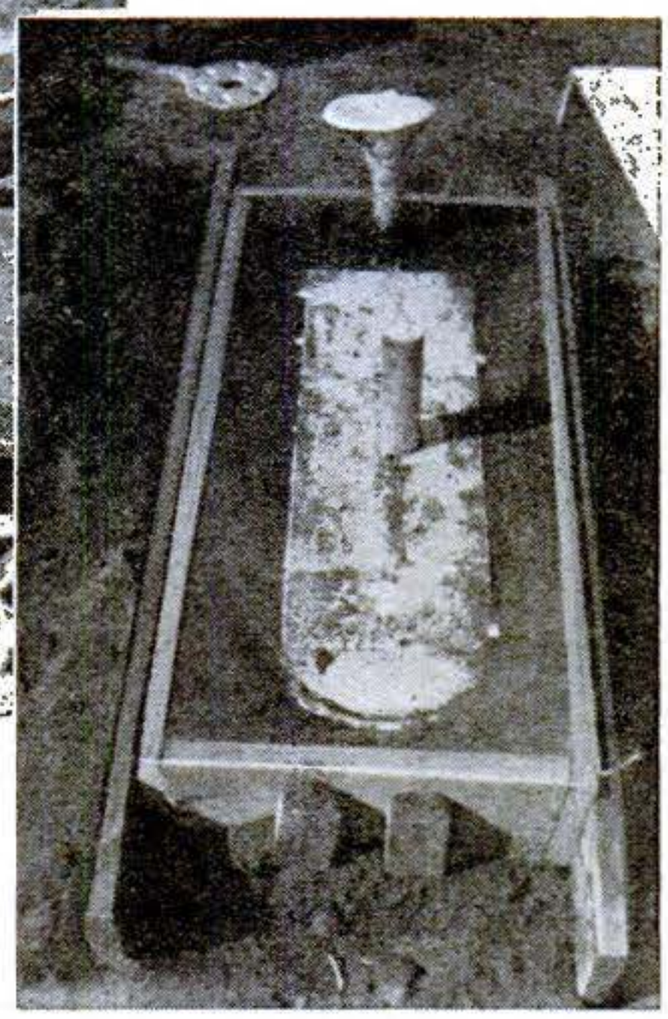


Set up at an air base in West Africa, this foundry never lacked work.

A casting is seen in the sand below after removing the top of the flask.



The Foundry That Stung the Mosquitoes

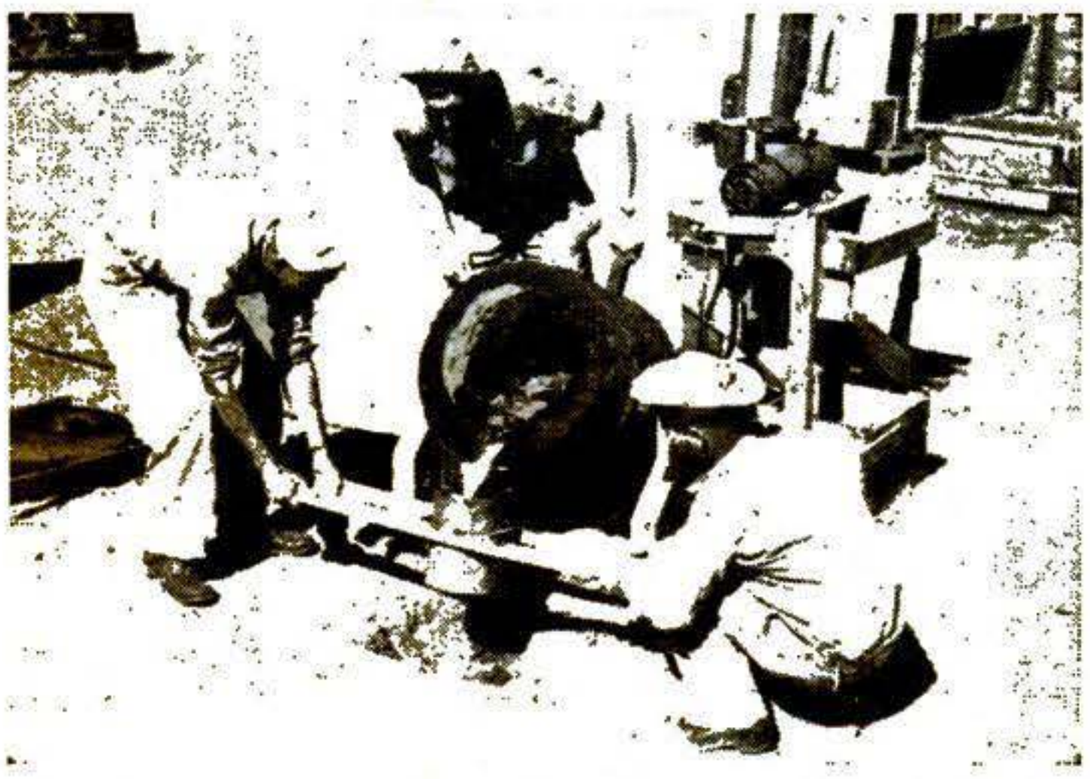
WHEN hordes of malaria-bearing mosquitoes came buzzing over an Army Transport Command base in French West Africa, they started a chain of events that led to the establishment of a foundry.

It was imperative that the mosquitoes be destroyed. A call was sent out to find a power duster for use on their swampland breeding grounds, but none was available. The only alternative was to build one. This was done—but the prevailing dampness quickly warped its wooden parts out of shape. A duster made of metal seemed to be the only answer. This would require a foundry, for aluminum castings were needed.

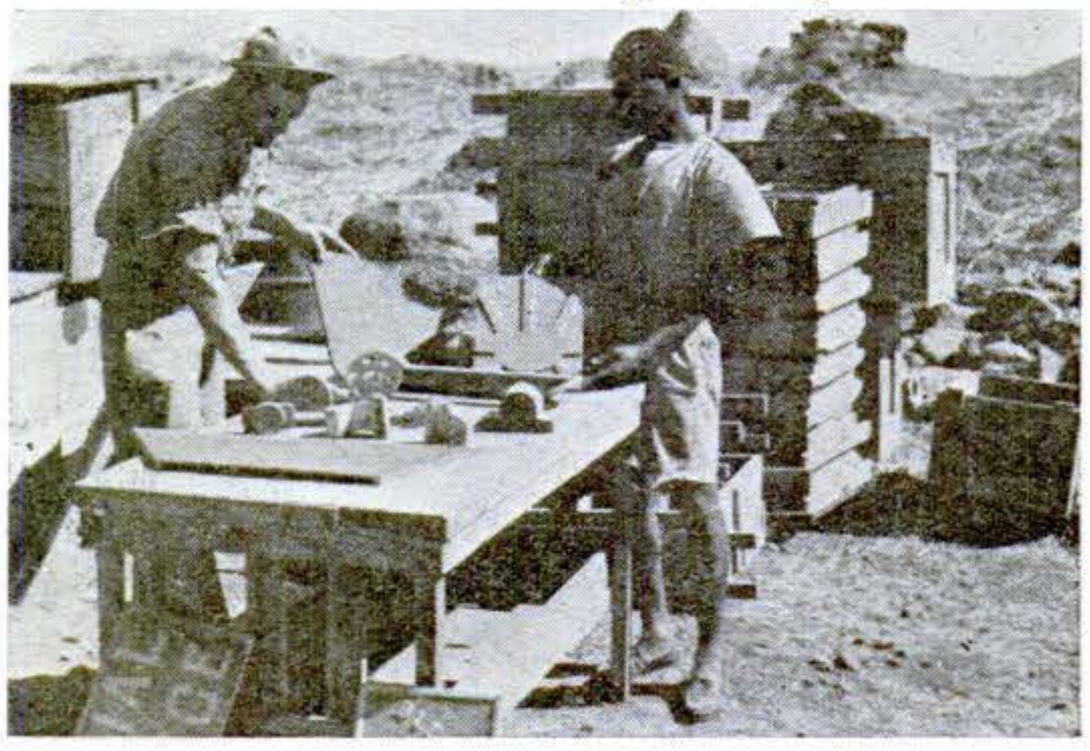
Sgt. Claude R. Strickland, once a foundryman, set to work. He cut an oil drum in two, mounted one half on trunnions, lined it with clay to a thickness of 4", cut a hole in the side to receive the burner, and installed a snug-fitting top in which a hole had been cut for the escape of gases. An air compressor and a homemade oil-air torch supplying heat of about 2,300 deg. F. completed the furnace unit.

Flasks in which sand could be tamped around wooden patterns were built from shipping boxes, a bucket was equipped with handles to serve as a ladle, and the sergeant's foundry was ready. The duster was cast—and the mosquitoes eliminated.

But the sergeant's work did not stop. He kept his foundry in operation throughout the remaining months of the war, casting metal parts to fill a variety of needs around the busy air base.—LEO KARTMAN.



Mounted on trunnions, the oil-drum furnace could be tilted to pour the molten metal into a ladle.



Making wood patterns of needed parts was the first step. In the background above is a pile of flasks.

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LIGHTER MOMENTS

with fresh Dated "Eveready" Batteries

FOR A LONG TIME, you had to *take* whatever flashlight batteries you could *get!*

But that time has passed. "Eveready" Flashlight Batteries are back. You can buy them. Ask for them at your dealer's.

And that's good news indeed. For, although flashlight batteries may look alike on the *outside,* that similarity is only skin-deep. There are important differences *inside* every "Eveready" Battery —differences that mean a longer life of stronger light. Differences that have made the "Eveready" flashlight battery the largest seller in the world!

"I'm afraid he isn't quite reconverted yet!"

Fresh DATED BATTERIES Last Longer

Look for the date line

EVEREADY

TRADE-MARK

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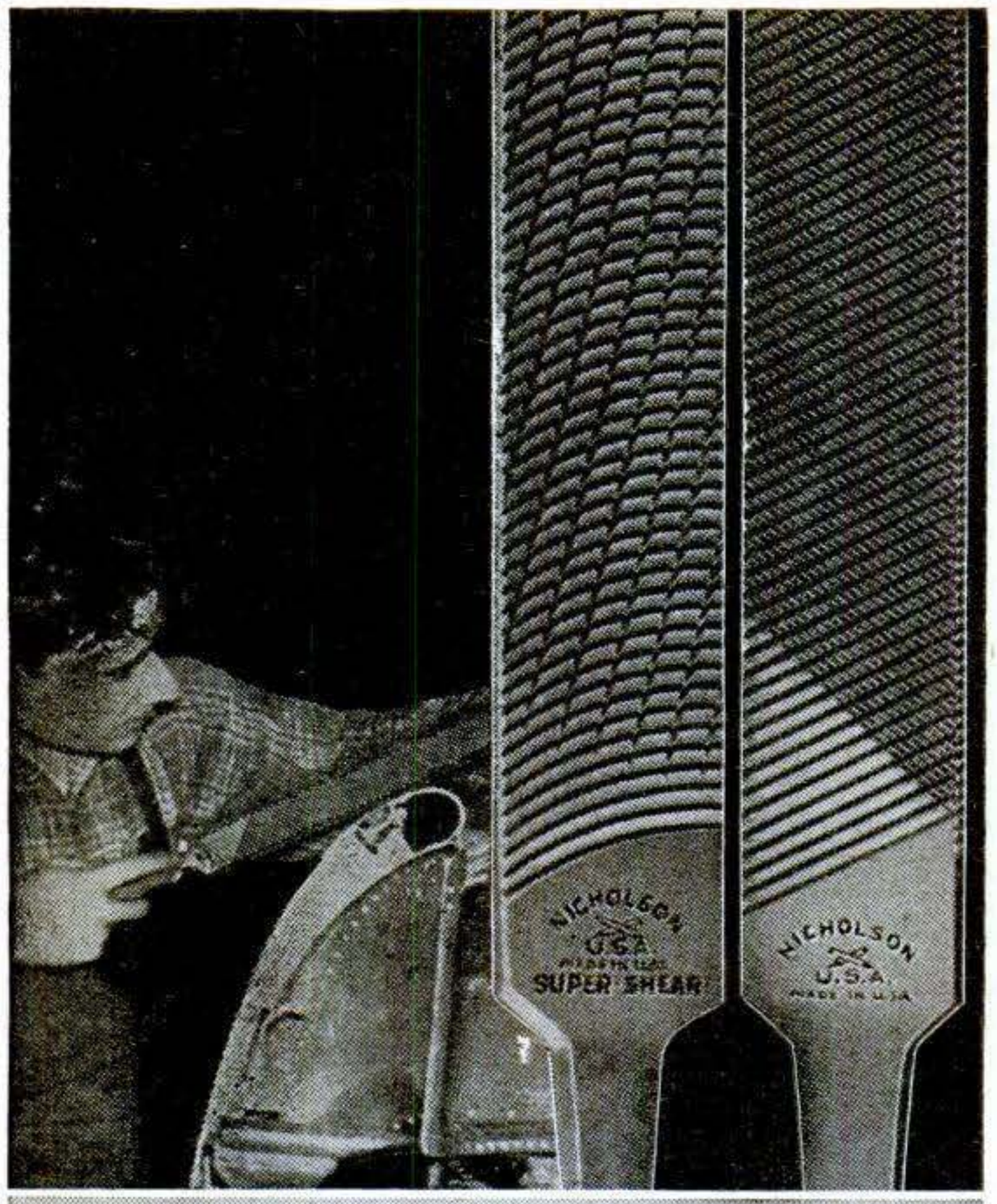

Files for aluminum

MANY of today's tools for working aluminum far outmode those of pre-war days. In files Nicholson has perfected these two distinctive types (illustrated above):

NICHOLSON SUPER-SHEAR FILE *(left)* —This is a recently developed curved-tooth file that "smooths as it roughs." Its milled "razor-sharp" edges can whittle down a piece of aluminum in amazingly fast time, with the final stroke leaving the surface scratchlessly smooth. Excellent also for plastics, bronze, brass, babbitt, cast iron and annealed tool steel.

NICHOLSON ALUMINUM "TYPE A" FILE—a special-cut file combining moderate cutting speed with good finishing qualities. Deep, "open-throat" upcut and fine overcut break up the soft aluminum filings, permit file to clear itself, overcome chatter, and prevent taking too large a bite.

FREE BOOK, *"FILE FILOSOPHY"*—48 illustrated pages on kinds, use and care of files.

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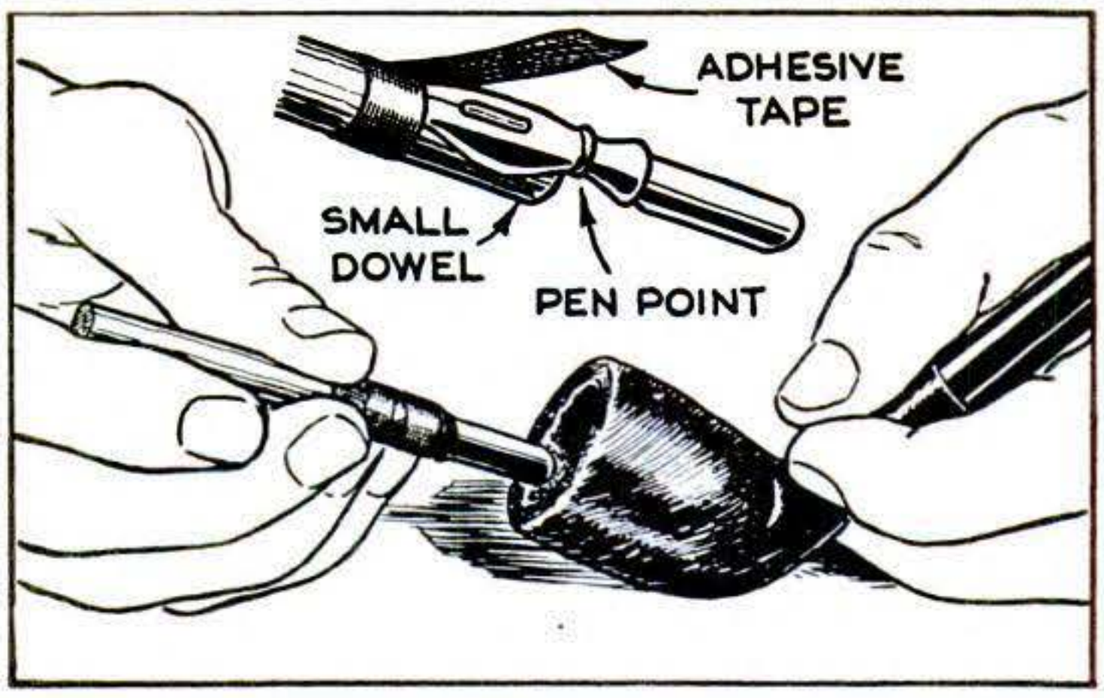
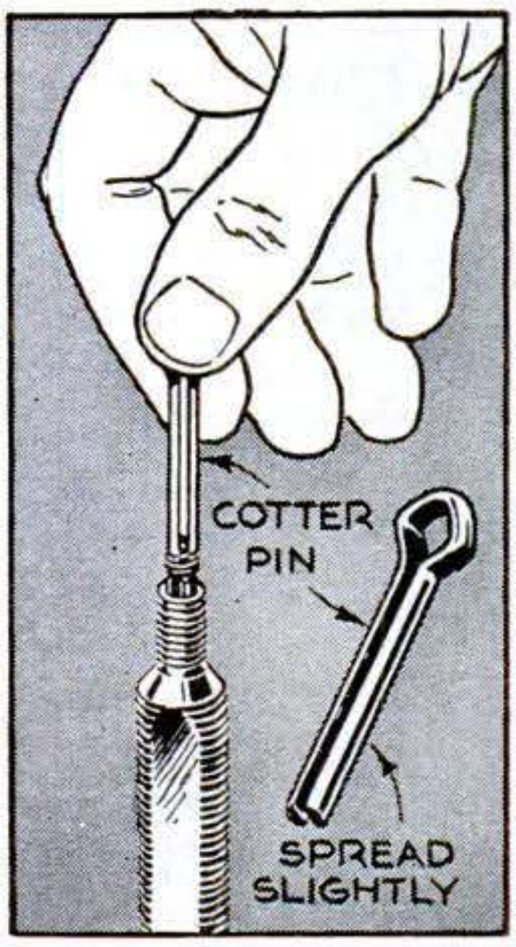


Pipe Bowl Reamed with Pen Nib

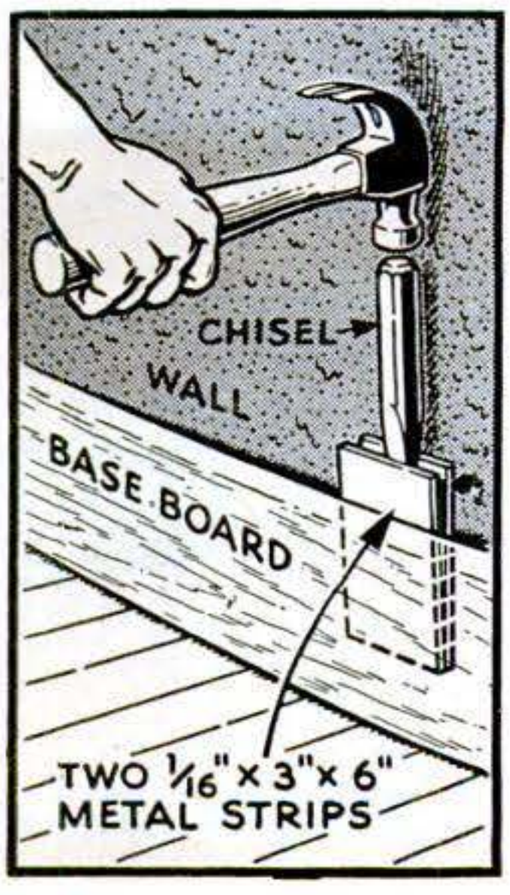
TAPED to a small dowel with the point reversed, an ordinary pen nib will serve admirably as a pipe-bowl reamer. Secure it with several windings of adhesive tape and make certain that the sharp end is covered. If you wish, the dowel can be painted and a hole drilled through one end so that it can be attached to and carried on a key ring.—HERMAN KLEIN.

Cotter Pin Will Remove Valve Core

IN AN emergency, the core of a tire valve may be removed with a cotter pin. For best results, the jaws of the pin should be the same length and be spread just enough to fit snugly over the core. A slight twist usually will be sufficient to loosen and remove the core. If the core is tight, the pin may be gently turned with pliers.—L. E. B.



Baseboard Removed With Wedge



Two thin strips of metal used with a chisel and hammer as illustrated here will pry off a baseboard without damaging either the plaster or wood. Begin the operation at a joint, then work along the board. The metal strips should be just thick enough so that little or no springing will occur during the wedging.—J. ROTH.

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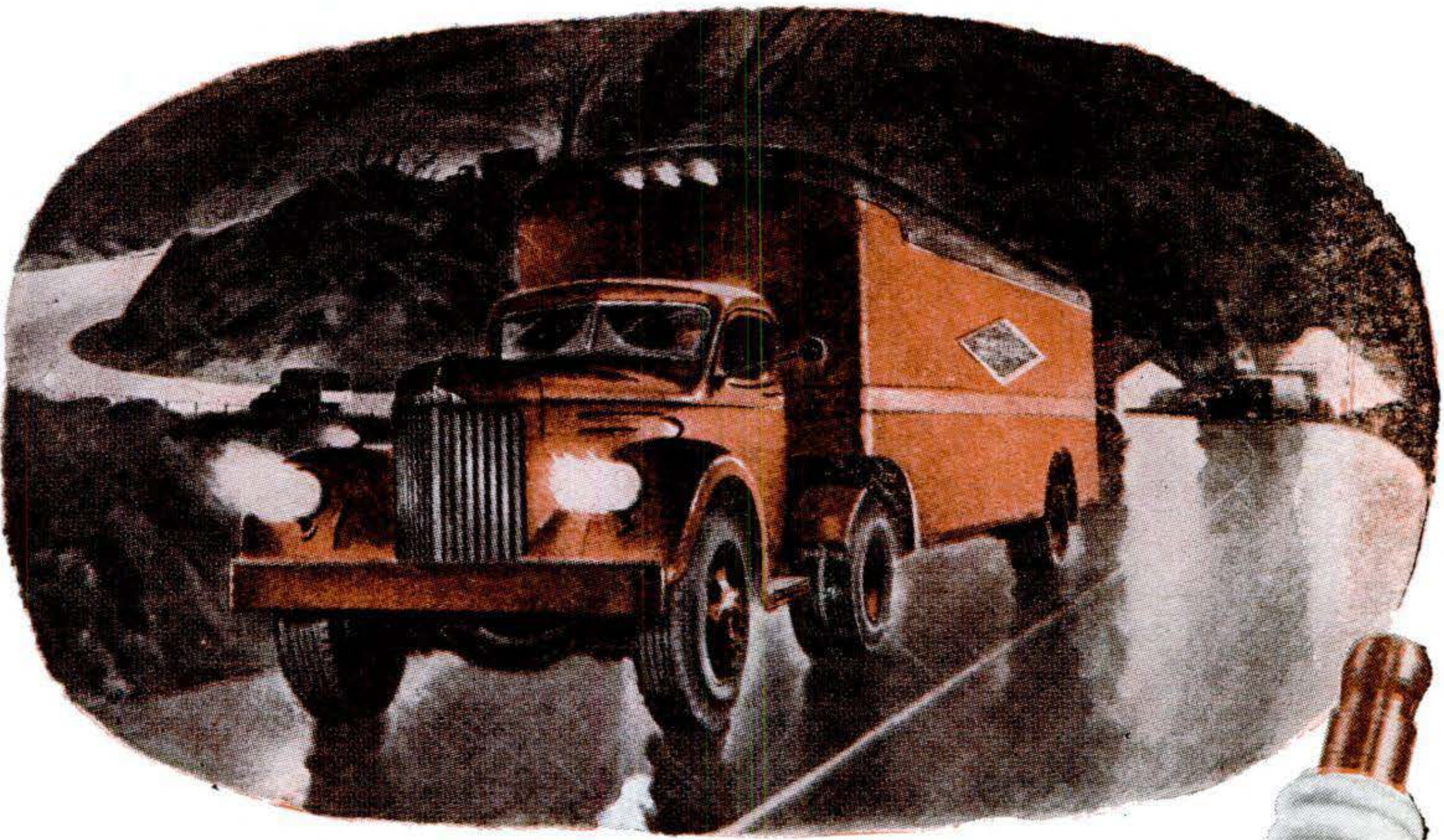
Here's why most Truck Fleets specify Champion Spark Plugs



THEY'RE DEPENDABLE!

When most of the country's leading truck fleets—to whom spark plugs are a cold matter of cost per ton mile—specify dependable Champions, you have substantial proof that Champions will insure maximum economy and peak performance in your engine. Champion Spark Plug Company, Toledo 1, Ohio.

FOLLOW THE EXPERTS . . . DEMAND DEPENDABLE CHAMPIONS FOR YOUR CAR

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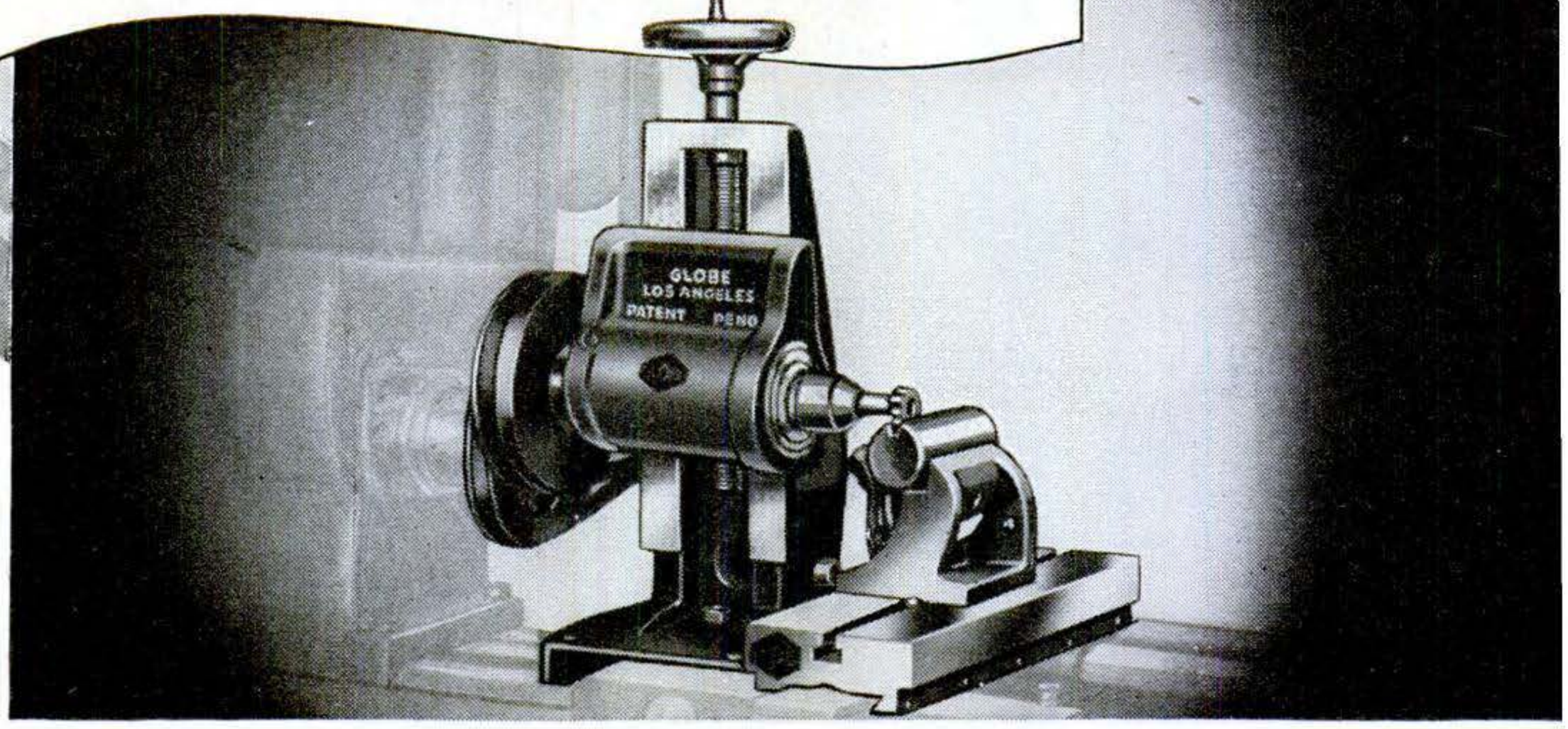
Ingenious New
Technical Methods
To Help You with Your Reconversion Problems



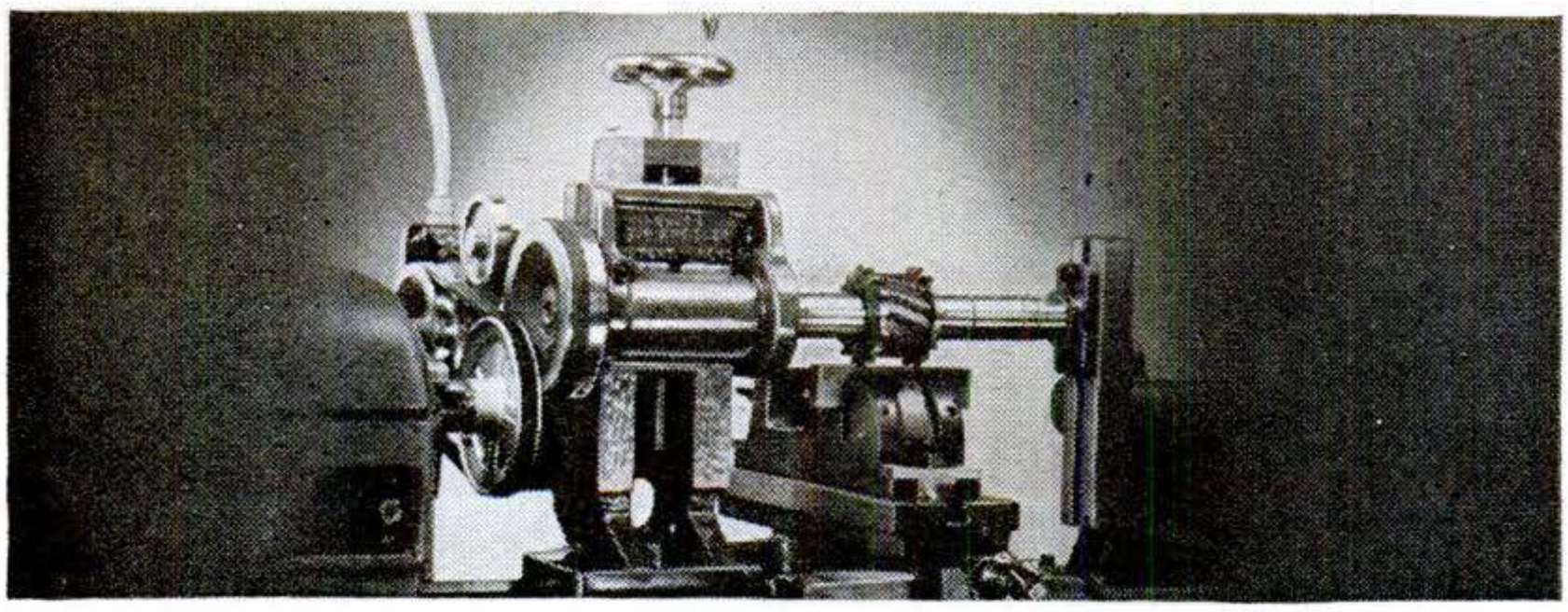
New Unit Makes Milling Machine Out of Lathe in 3 Minutes!

The Globe Miller, a unit quickly attached to a standard lathe, performs the same operations as a costly milling machine. Installed in 3 minutes or less, the Globe Miller operates almost identically to a standard milling machine. All controls are simple, highly accurate—and the miller is designed to utilize all speeds and feeds of the lathe.

It is accurate, durable and highly versatile. With minor adjustments and accessories, the miller will face castings; cut slots, keyways, and gears; perform slitting operations, etc. Quality materials and rugged construction enable it to stand the hardest use. It costs but a fraction as much as a standard miller. Its compact design makes storage possible underneath the lathe. Proved performance in wartime production, assures dependable service.

Performance has also proved that chewing gum helps you on the job—by seeming to make work go easier, time go faster. Today, you'll see good chewing gum on the market. But a shortage still exists. Wrigley's Spearmint Gum is taking this space for your information, and for now, we'd like to suggest that you use any good available brand. Remember: It's the chewing that's good for you.

You can get complete information from
Globe Products Mfg. Co., 3380 Robertson Boulevard
Los Angeles 34, California



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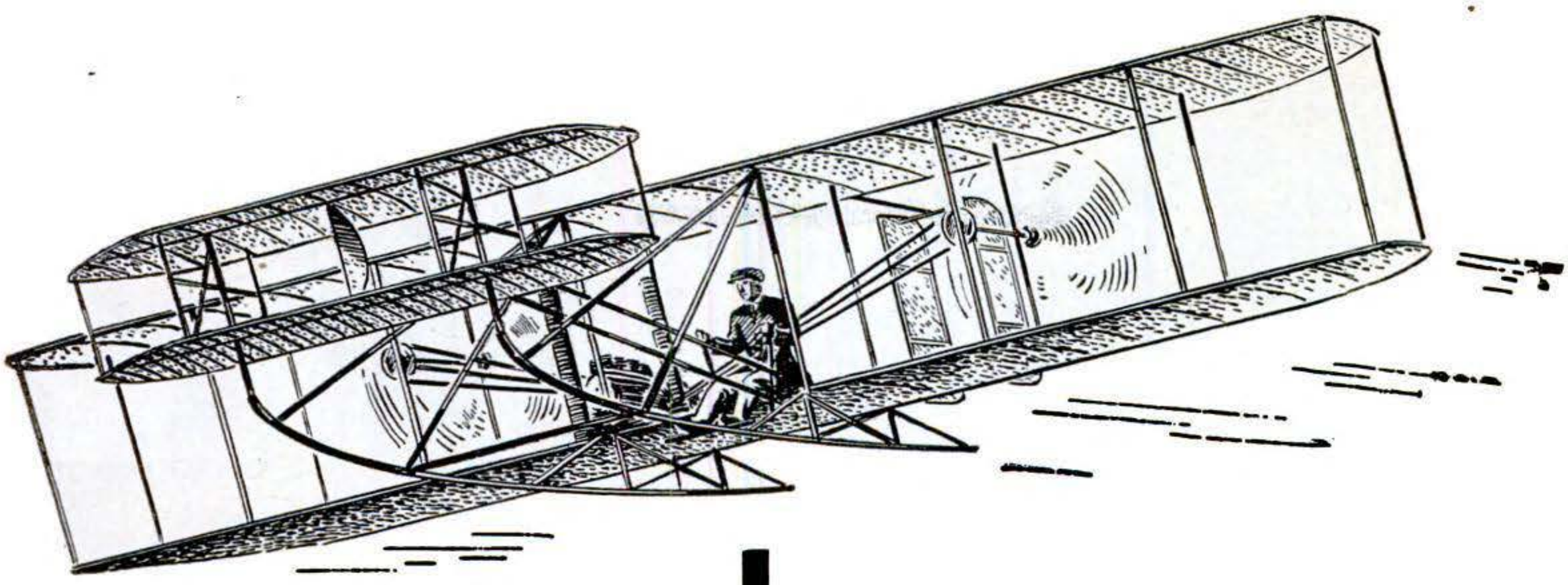
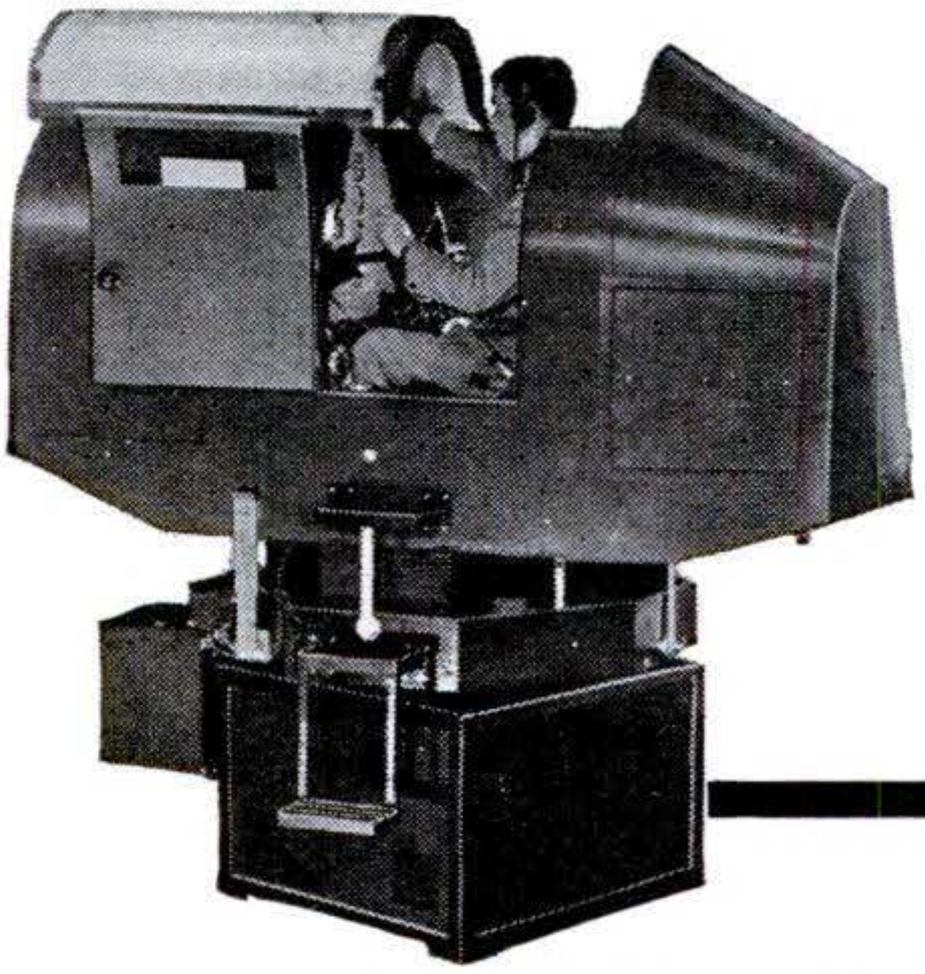


WRIGHT BROTHERS' *KITTY HAWK*
FIRST AEROPLANE TO FLY



THE Link
FIRST TRAINING DEVICE
TO *SIMULATE* AIRPLANE FLIGHT

Take a ride in the LINK and you'll learn more about *modern* airplane flight than if you could take the controls of the famous "Kitty Hawk"! For the LINK has kept pace with aviation for the past twenty years. Earth-bound, it is amazingly flight-like.

Standard training device of the Air Forces and the airlines, the LINK reproduces with remarkable and scientific accuracy practically all the characteristics of a modern plane in flight. In it you learn to climb, bank, glide—how to avoid stalls, how to keep "on the course" in darkness and weather, how to reach an airport guided by radio and instruments alone.

Soon Link training will be available to every air-minded man and woman, girl and boy. And when you learn to fly your own plane, your time in the Link will prove invaluable. Link Aviation Devices, Inc., Binghamton, New York. Makers of Link Trainers, Crew Navigation Trainers and other devices contributing to the safety of flight.

***Link training is your first step into the* FLYING AGE**

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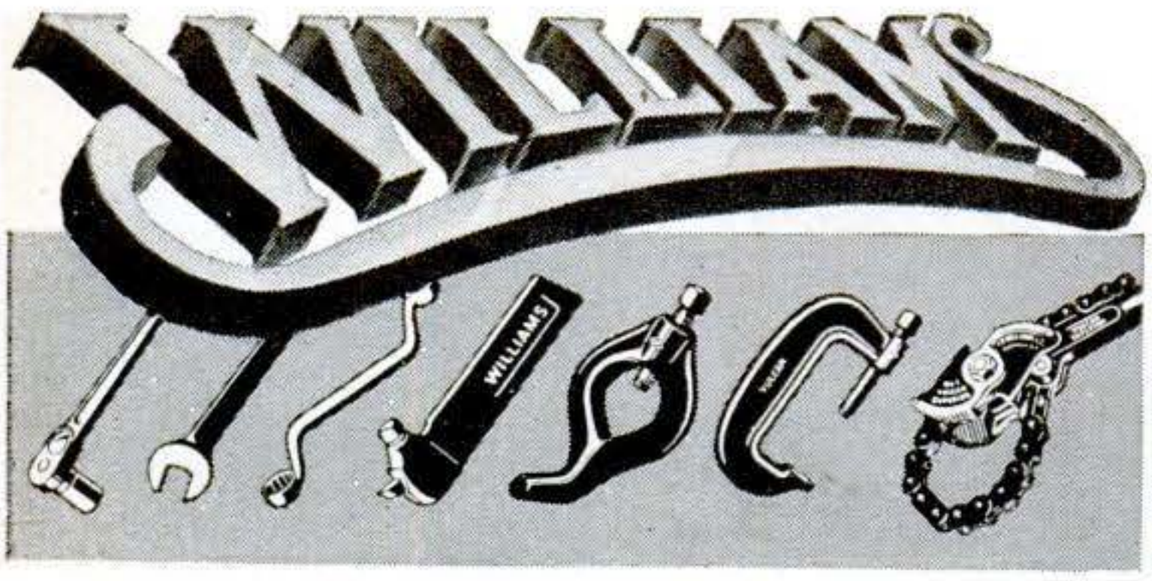
All Williams Clamps are DROP-FORGED

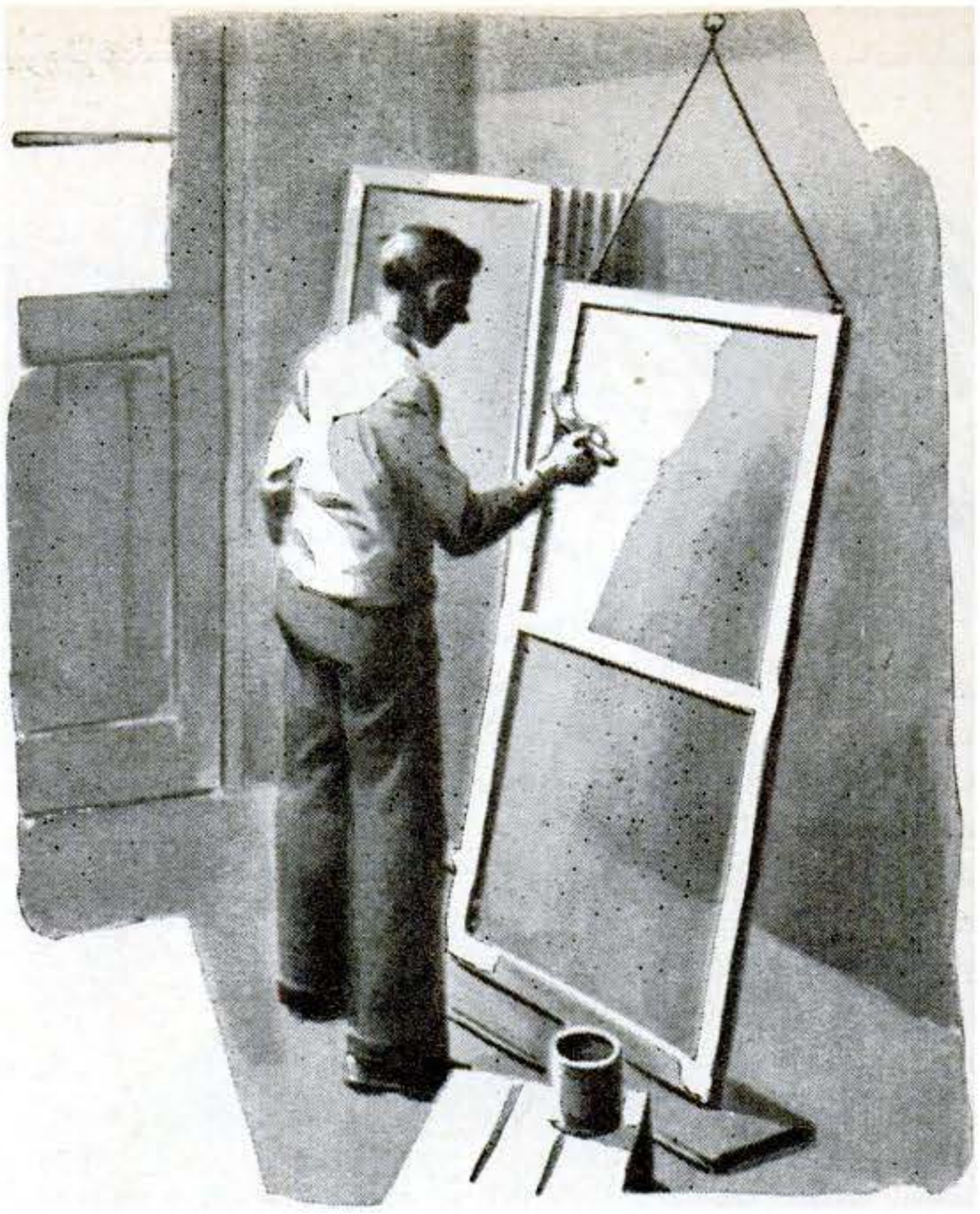
● The more-than-usual holding power of Williams Clamps results from a combination of sound design and *drop-forged* strength. Despite their relative lightness in comparison with clamps made by other processes, you'll find Williams Clamps won't *spring* or *twist* under severe load. All Clamps are forged from selected steel and heat-treated; screws, of special steel, are hardened and tempered. Available in a wide range of sizes. Write Dept. S-36 for free Tool Data Sheets.

J. H. WILLIAMS & CO.

BUFFALO 7, NEW YORK



DROP FORGINGS AND DROP-FORGED TOOLS



Screens Supported for Painting

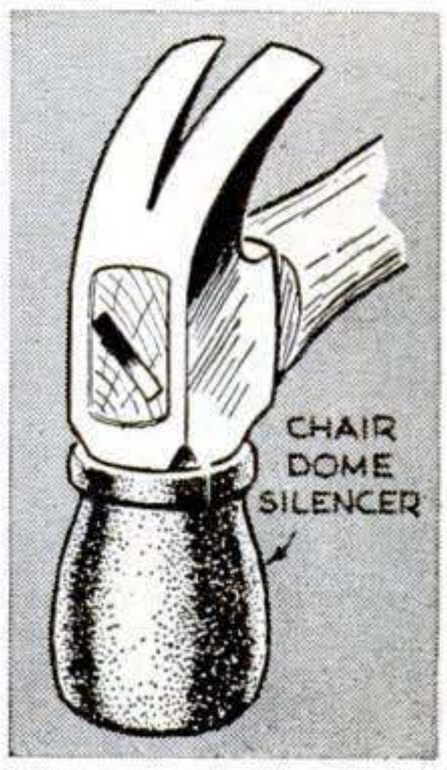
STRONG cord looped through a ring in a cellar beam and tied to the screen hangers will support a window screen upright so that both sides can be painted without waiting for one to dry. The screens should be placed on a board, newspaper, or drop cloth both to protect the floor and to keep them from collecting dust. Finished screens may be left hung to dry or moved to make room for the next.—ESTHER SNYPE.

How to Mix Flat Paint Undercoater

IF YOU have trouble finding ready-mixed flat undercoater for painting new plaster, you can make your own by mixing ½ gal. flat white paint, 1 qt. spar varnish, 1 pt. linseed oil, and 1 pt. turpentine.—J. E. BIRD.

Soft Covering for Hammer Head

USE of a rubber dome silencer of the kind sometimes found on the feet of chairs will convert an ordinary claw hammer for work on materials easily marred. The silencers come in a size that fits large hammers of the home type, and one can be slipped readily over the striking surface.—DAVID B. CLAPP.



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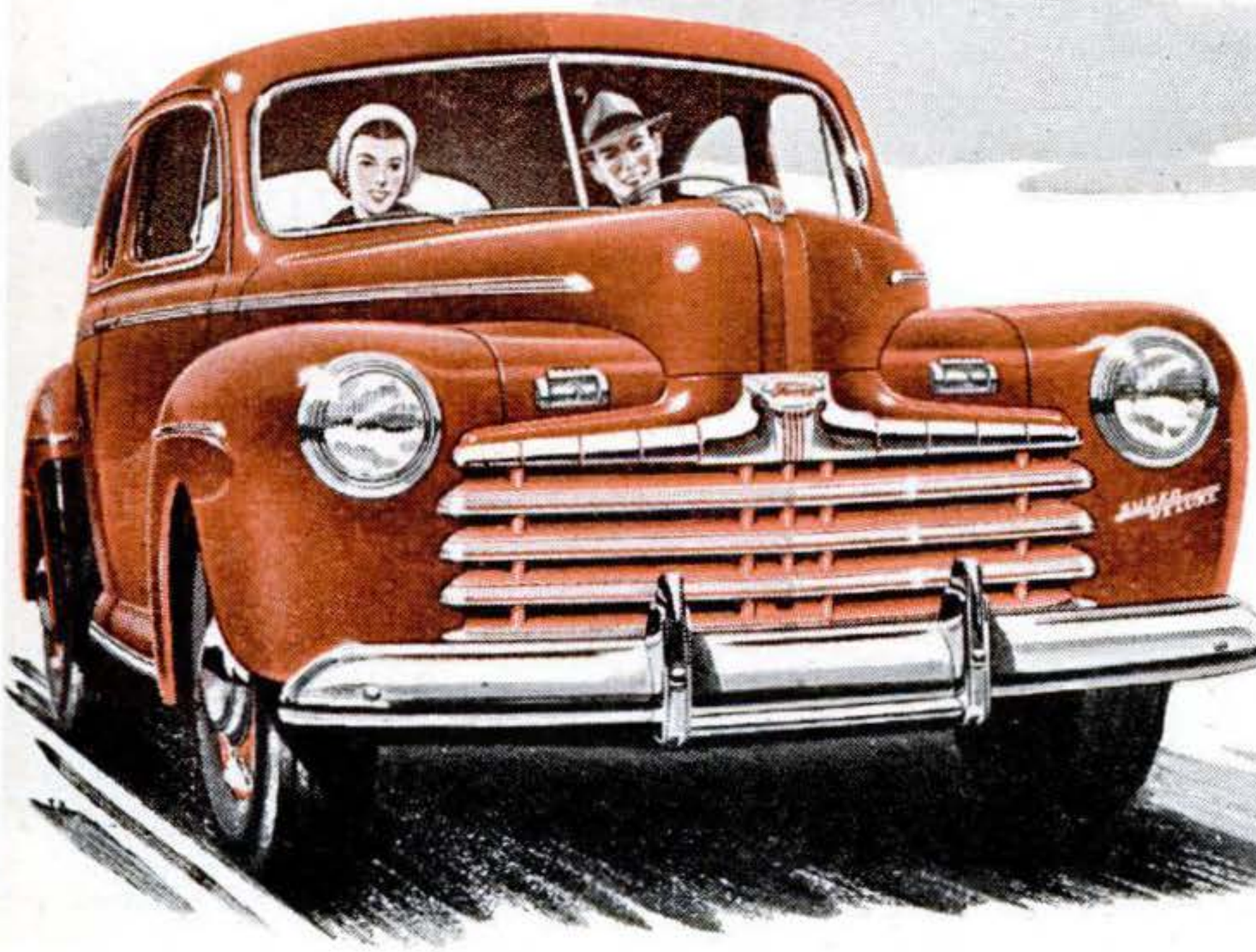
Young looking . . . with lots of "hustle"

Any way you look at it—this new 1946 Ford has what it takes! New comfort. New economy. New beauty. And under the hood, new stepped-up power to match its eager, youthful look . . . Inside, you'll find colorful fabrics and trim in smart two-tone combinations. Seats that are wide and deep . . . For a smooth and level ride, this car has new multi-leaf springs—long and slow-acting. While extra-large hydraulic brakes of a new design assure you quick, soft stops . . . Two great engines to choose from: the V-8, now increased from 90 to 100 horsepower—the 90 horsepower Six . . . See this smartest Ford car ever built—at your Ford dealer's today.

FORD MOTOR COMPANY



THERE'S A

Ford

IN YOUR FUTURE

Ford

TUNE IN **. . . THE FORD SHOW . . . CBS, Tuesdays. 10-10:30 P.M., E.S.T. THE FORD SUNDAY EVENING HOUR . . . ABC, Sundays. 8-9 P.M., E.S.T.**

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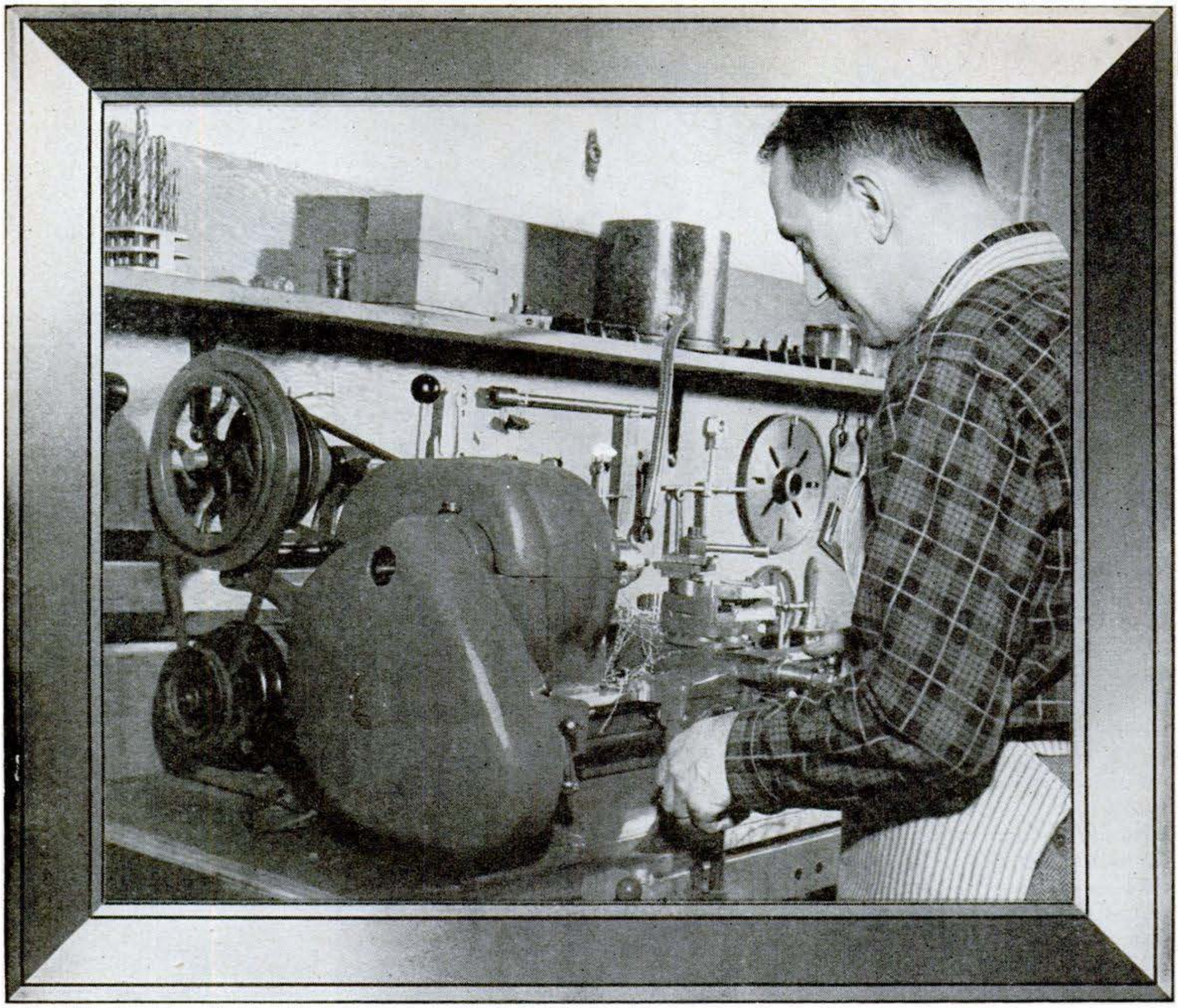

Portrait of a HAPPY MAN!

Relaxation and recreation to the hum of busy tools . . making useful things for home or business . . making quick repairs to home equipment — you're lucky if you have such a practical hobby!

Atlas tools will be available soon to help you equip your shop — at exceptionally low cost — for every project you want to undertake. They will give you the precision you need for close tolerance work — the strength required for heavy cuts. They are tools designed in every way to help you make the most of your mechanical skill and ability on useful home projects.

Ask your distributor to let you know when you can see and operate Atlas tools in his showroom.

SEND FOR FREE CATALOG

You can get a preview of what to expect by sending for this new 64-page Atlas catalog. Hundreds of illustrations of special tools and operating views. Write for your copy today. Atlas Press Company, 355 N. Pitcher St., Kalamazoo 13D, Michigan.

Atlas 4 TOOL TEAM

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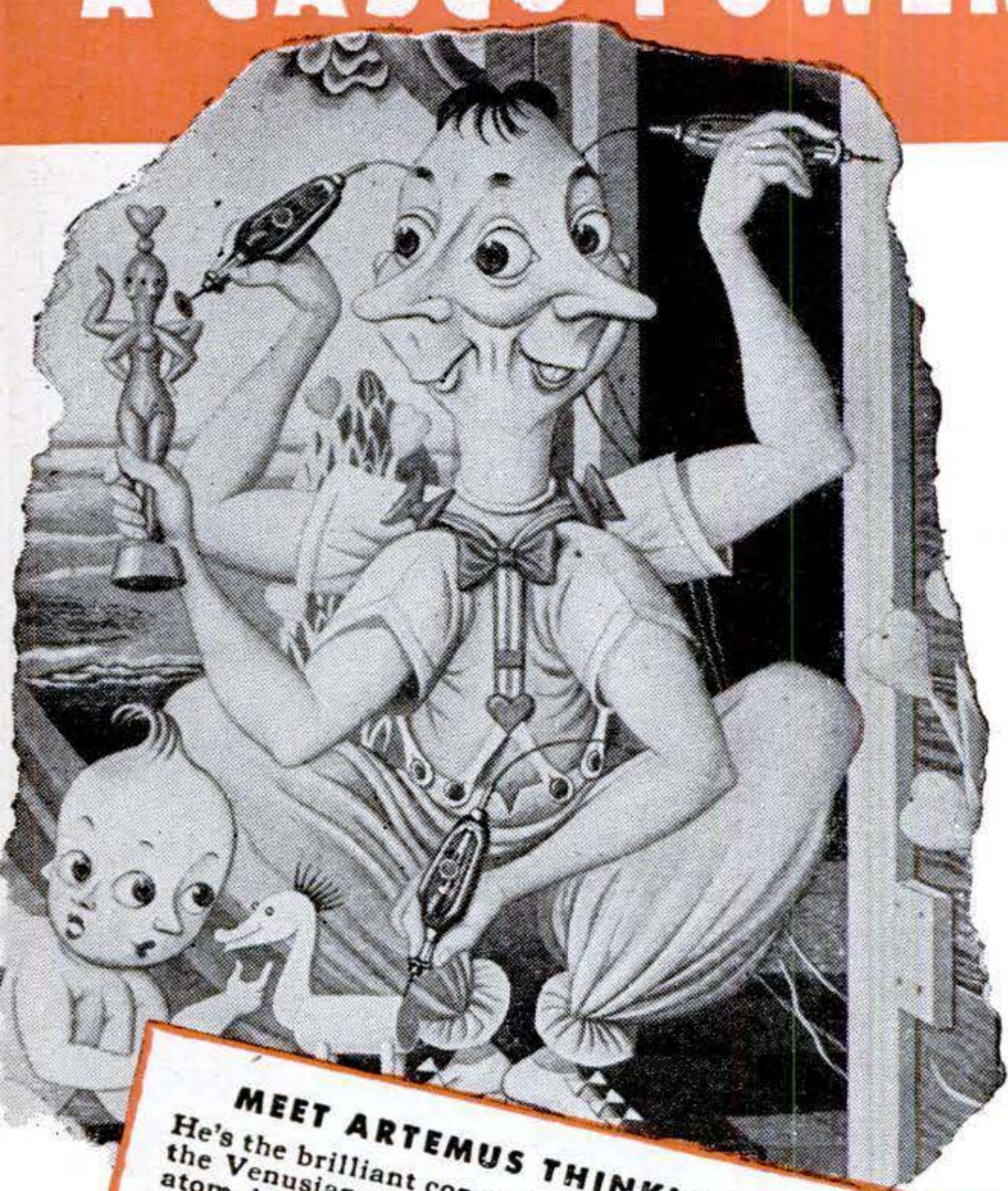
SEE WHAT YOU CAN DO WITH A CASCO POWER TOOL KIT



MEET ARTEMUS THINKLE OF VENUS

He's the brilliant concept of artist Boris Artzybasheff—the Venusian you'll meet and like as soon as the new atom-drive space ship is completed. Mr. Thinkle's four hands (notice they're all right hands) give him a slight edge—but you can do everything he's doing with a Casco Power Tool Kit—and more!

- ***It's hand-sized—handles as easily as a fountain pen!***
- ***Gets into small places—does fine detail work***
- ***Works on metal, glass, wood or plastic***
- ***Acts as both a repair and a hobby tool***

5 ATTACHMENTS DO ALL THESE JOBS BETTER AND FASTER

- Sanding
- Carving
- Sawing
- Finishing
- Drilling
- Engraving
- Grinding
- Sharpening
- Burring
- Burnishing
- Inlaying
- Cleaning
- Polishing
- Routing
- Dressing
- Cutting
- Rasping
- Brushing
- Touching Up
- Mortising

. . . and many other machine and hobby uses

watch

CASCO

The Casco ELECTRI-CRAFT Power Tool Kit Not available now but your dealer will have full details soon. Keep in touch with him! Casco Products Corp., Bridgeport 2, Conn.

for new and unusual contributions to better living

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CHOOSE THE RIGHT GLUE FOR THE JOB!

All glues make things "stick." But no one glue is best for all gluing jobs. Here are simple rules to follow:

1. Use Casein Glue—for joints that stay dry—toys, cabinets, furniture, interior wall panels, and other indoor objects that are not exposed to water or weather.

Casein Glue (CASCO) is self-bonding. It's easier, more foolproof to use than resin because it "fills" poorly fitted joints and sawed surfaces, and sets at any temperature above freezing. Yet it is water-resistant, withstands all indoor conditions.

2. Use Resin Glue—for joints exposed to moisture—outdoor furniture, screens, in damp basements, etc. . . . also for *stain-free* veneering of acid woods.

Urea Resin Glue (CASCAMITE) is made especially to meet these requirements. *Cascamite* is highly water-resistant, moldproof, stainfree. More care must be exercised in its use for best results. Joints must be well-fitted, wood surfaces smooth, pressure clamps used, and room temperature must be at least 70°F.

This is powdered Casein Glue

Complies with Navy and government casein glue requirements. Mixes in cold water. At hardware stores. 10¢ to 65¢.

This is dry powder Urea Resin Glue

Complies with Army, Navy urea-resin glue requirements for lifeboats, field equipment. Mixes in cold water. At all hardware stores. 10¢ to 85¢.

FREE GLUING GUIDE

CASEIN COMPANY of AMERICA, Dept. PS36
350 Madison Avenue, New York 17, N. Y.

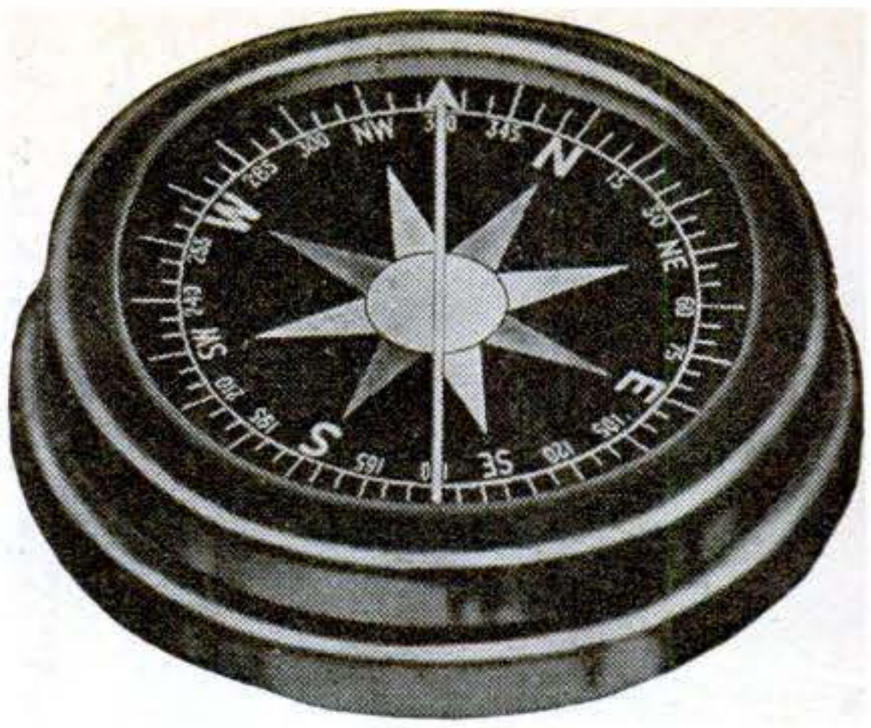
( ) **GLUING GUIDE**
Complete directions for both glues. Home workshop jobs. Gluing hints.

( ) **CASCO PROJECTS**
Describes 24 furniture projects by famous American designers. Tells how to get free plans

( ) **CASCAMITE WATER PROJECTS**
12 boat and water projects by Wm. F. Crosby described. Tells how to get free plans.

NAME_____

ADDRESS_____



New Compass Has Plastic Case

THIS direct-reading pocket compass is made entirely of plastics except for its supersensitive magnets, bearing, and pivot. A special nonfreezing liquid acts as a brake and stops the card at the exact direction indicated within three seconds. Measuring 2½ by ⅝ inches, the unbreakable precision instrument is an adaptation of a battle-tested compass that was standard equipment on armored vehicles during the war. It is one of the newest products of the Sherrill Instrument Co., of Peru, Ind.

Milk-Can Carrier Saves Drudgery of Heavy Loads

A MINIMUM of effort is needed to move around heavy, bulky milk cans when you use the new Kan-Truk, a rubber-tired carrier made by the Dairy Equipment Co., of Madison, Wis. So light that a youngster can use it, the Kan-Truk is merely hooked on a milk can. It carries the container in a perfectly balanced, upright position so the milk will not spill. It is easily adjusted to fit different-size cans.

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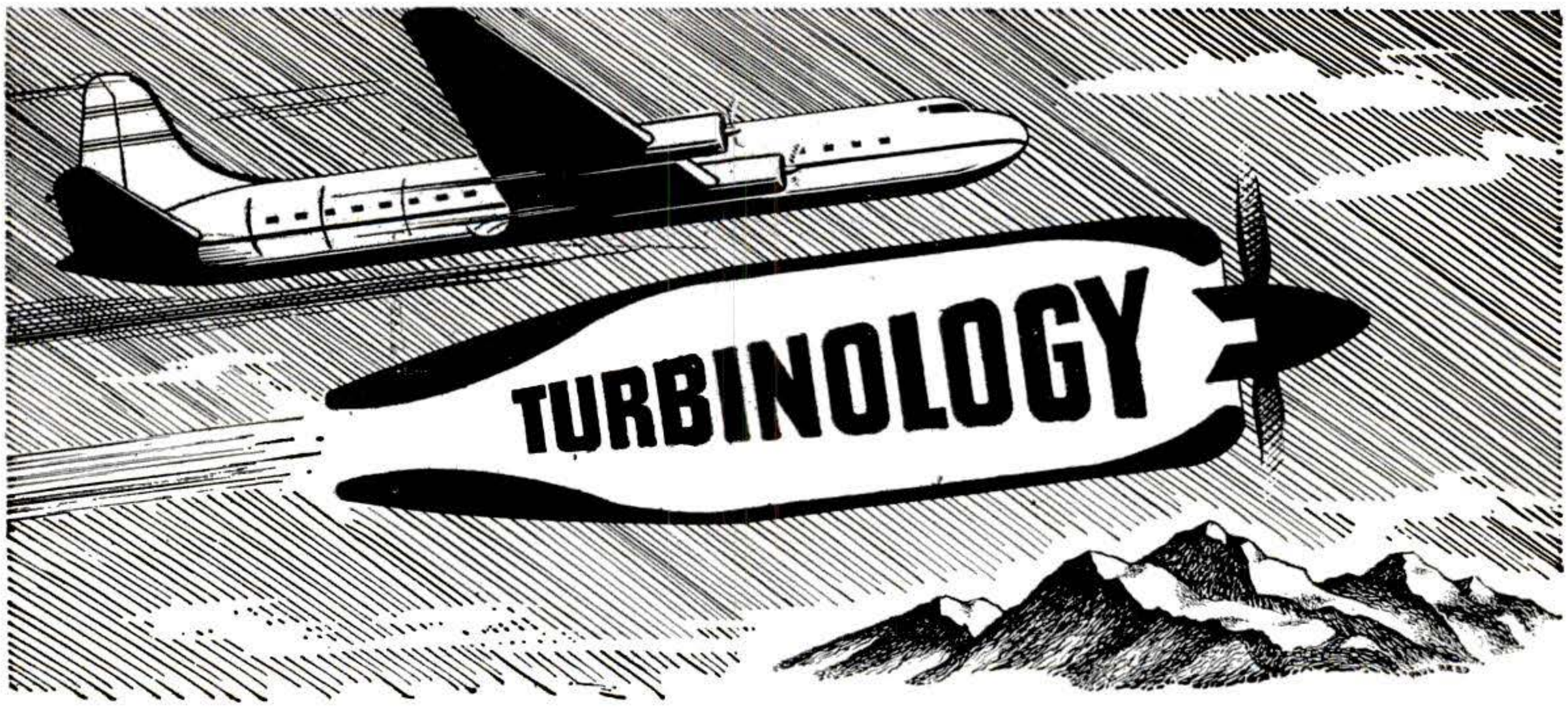
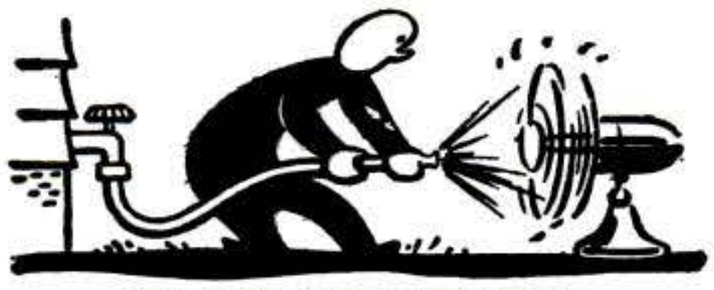


Wright Aeronautical Announces a New Type of Aircraft Engine . . . the Propeller Turbine

A tremendous and radically new source of aviation power, double the output of present engines is being developed by Wright Aeronautical. It is a propeller turbine, for use in gigantic new long-range planes racing through the stratosphere. The first Wright turbine will have double the power of today's largest Cyclone. Other models will be much larger.

WHAT IS A TURBINE?

Blow on the blades of an electric fan. They will begin to turn, though slowly. Direct the nozzle



FAN SPINS WITH WATER SPRAY

of a garden hose against the blades. They will turn faster. Or turn the air stream of a filling station tire pump on them. They will spin much faster.

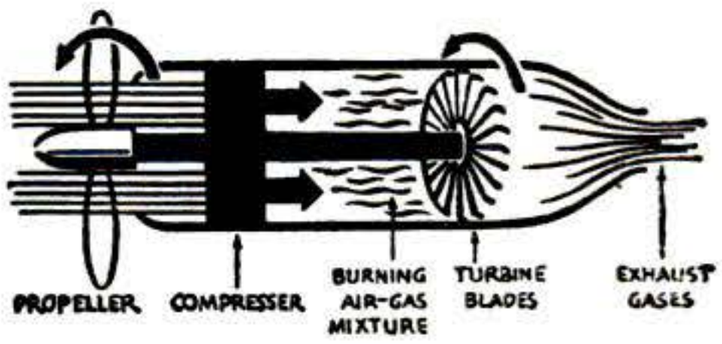
In a regular turbine, much the same result occurs. There is a turbine wheel made up of fan-like blades placed close together. A stream of super-heated steam or high-pressure water strikes against the blades with thousands of times the energy of a garden hose and forces them to turn the turbine wheel and its shaft. In ocean liners, the rotary motion of the turbine is used to turn the ships' propellers. On land, the turbine is made to turn by steam or the force of water dropping over a dam or waterfall, and usually drives an electric generator.

DAMS HAVE TURBINES

NEW PROBLEMS ARISE

Lacking both waterfalls and boiler houses in the air, Wright Aeronautical had to devise a new method of creating a high pressure stream to strike the turbine blades and thus put power into a propeller shaft. Wright engineers turned to gasoline, burning it with compressed air. The result is a terrific expansion of exhaust gasses and air made to expand by heat. The only way the gasses can escape is through the turbine blades. Just as you set a revolving door in motion by pushing against it as you go through, so the gasses set the turbine wheel in motion by pushing against the blades as they pass through.

The turbine is simple in theory but years of research have gone into making it a fact. New metal alloys were evolved, to withstand temperatures far above super-heated steam. To fill the job of waterfall or steam boiler, Wright engineers added an air pump, driven by the turbine shaft, to supply a constant source of compressed air. They geared down the furious turbine speed to a proper propeller pace.



Their total result is a turbine of unprecedented horsepower. And just as the first Cyclone doubled, then quadrupled in power, so this first Wright turbine will be replaced by steadily larger models.

This is the first of a series of explanatory ads on the Wright Aeronautical propeller turbine.

WRIGHT
AIRCRAFT ENGINES
DIVISION OF
CURTISS WRIGHT
FIRST IN FLIGHT
Wright Aeronautical Corporation • Paterson, New Jersey

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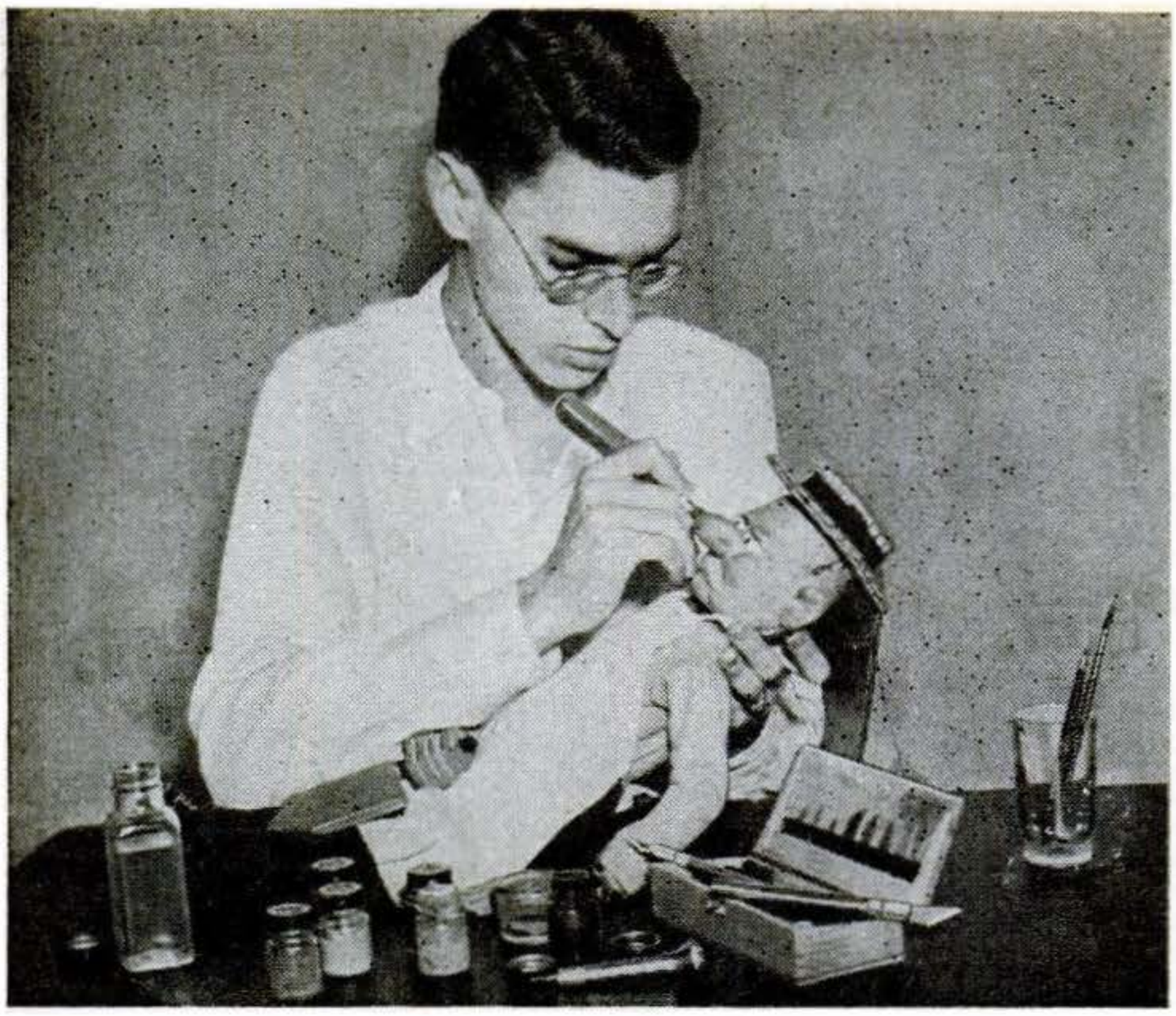


BOY CARVES BUTCHER...WITH X-ACTO!

Patriotic Puppet Fights Black Market

Hobby Expert says X-acto Knives "Marvelous" for Model Building, too

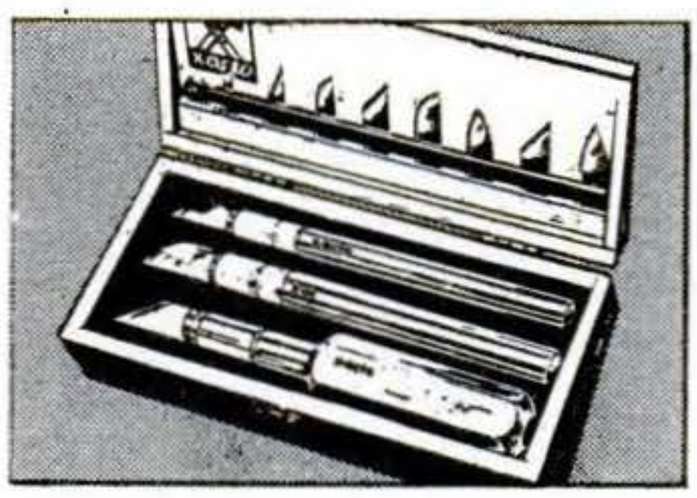
Sanford Solarz of Brooklyn is a versatile young hobbycrafter. And he finds X-acto Knives the most versatile of tools.

At Midwood High he made wooden puppets for the school play against black markets. X-acto Knives, he says, were "*perfect* for getting just the right expression on the puppets' faces".

And for his model planes (which have won him prizes, and an exhibit at Brooklyn Museum) X-acto's variety of blades and handles produced "results which would be impossible with ordinary tools".

For ship models (yes, he makes those, too) he has "yet to find a better set of tools". He uses the heavy and medium-weight X-acto for hull and deck parts, and the light No. 1 Knife for shaping mast and yard arms.

You'll do a slicker job at *your* hobby, too, with X-acto. It's sharp as a surgeon's scalpel, easy to use as a pencil, gives you that confident feeling. You'll have a lot more fun with X-acto every time.



Singly or in sets

Here's the X-acto De Luxe All-Metal Knife Set – 3 firm-grip X-acto Knives, with 20 assorted, interchangeable blades, in a handy wooden chest. Complete, for $5. Other X-acto Knives and Knife Chests, from 50c to $3.50.

X-acto *

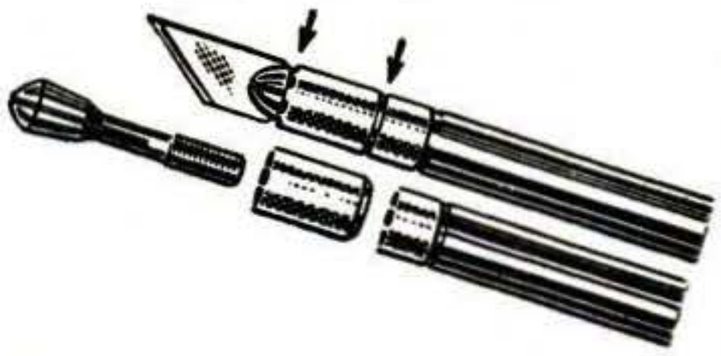
KNIVES & TOOLS

X-acto Knives & Knife Chests From 50c to $5.00

Buy where you see this sign. At better hardware, hobby and gift shops – or if not available write direct to X-acto Crescent Products Co., Inc., 440 Fourth Avenue, New York 16, N. Y.

*Reg. U. S. Pat. Off.

NEW FEATURE MAKES X-ACTO BETTER THAN EVER!



X-ACTO'S CHUCK COLLET device has always been one of its biggest advantages over ordinary knives. *Now it's been made even better.* The new collet grips blade more firmly. The blade tightens with less pressure, and extends further, allowing knife to get into deeper crevices. It's terrific!

HELPFUL "HOW-TO" BOOKLETS to help you have fun with X-acto. 10c each.

(1) How To Build Scale Model Planes

(2) Whittling Is Easy With X-acto

(3) Commercial Artists' Handbook

(4) Twelve Technics – The Knife As A Drawing Instrument

THEY ALL USE X-ACTO: Artists, photographers, leathercrafters, furriers, bookkeepers, lithographers, taxidermists, tree nurseries, printers. You'll find it useful in *your* work, too.

X-ACTO TOOLS, TOO!

Sander; Plane; Balsa Stripper; Hobbycrafter's Saw; Drill Holder and Pin Vise

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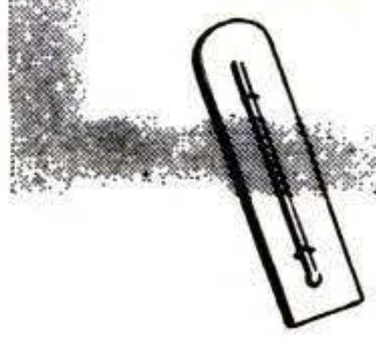
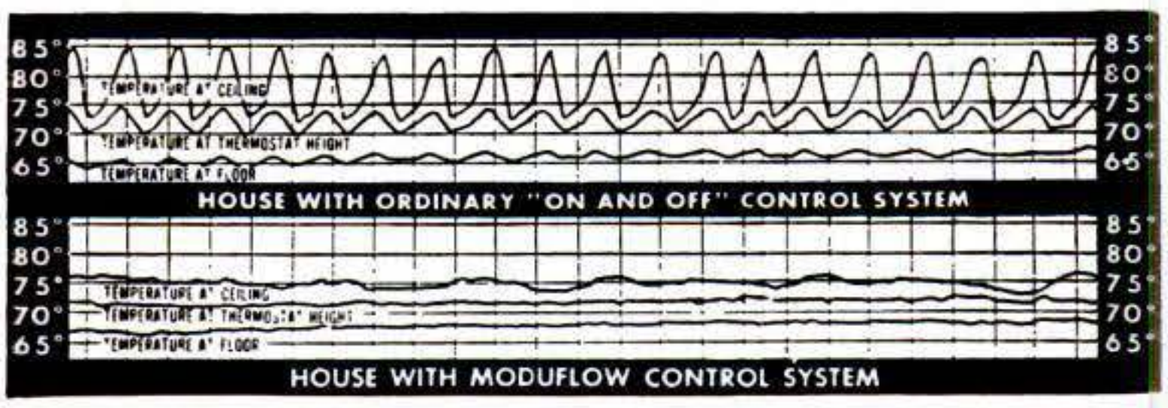
Give your living room
The THERMOMETER TEST



Some snappy day when the weather is below freezing, just try this thermometer test in your living room. You'll probably be amazed to find that there is as much as twenty degrees difference between the temperature at your ceiling and on your floor. (See chart below.)

That's because, in the average home, equipped with an ordinary on-and-off control system, the warm air rises to the ceiling, and the cold air forms in layers along the floor. But with Honeywell's new MODUFLOW control system, that's all different. By an ingenious method of control and supply, Moduflow nearly equalizes ceiling and floor temperatures. Much of the heat formerly wasted at the ceiling is used to heat the lower levels; result, blissful comfort from head to foot with greater efficiency of operation.

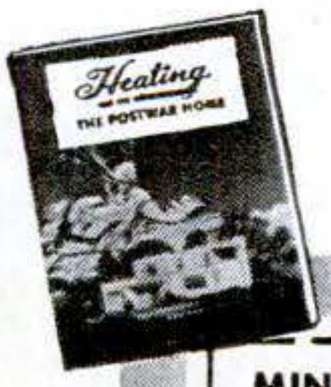
And here's the best news of all! Moduflow can be installed in your present automatic heating system. A limited number of Moduflow systems are now available. The sooner you order from your heating dealer, the sooner you will be able to enjoy the comfort of Moduflow. Mail the coupon today for an interesting booklet that tells how Moduflow will "evolutionize" house heating.



See how Moduflow smooths out the up-and-down temperatures caused by ordinary control systems. Shown above are actual temperature recordings taken in two identical houses — one with and one without Moduflow. Without Moduflow, temperature varies as much as 20 degrees from floor to ceiling. With Moduflow there is comfort temperature from ceiling to floor.

MODUFLOW

THE NEW HONEYWELL HEATING CONTROL SYSTEM



Send for this book FREE!

MINNEAPOLIS-HONEYWELL REGULATOR CO.
2762 Fourth Ave. So., Minneapolis 8, Minn.

Please send my free copy of "Heating and Air Conditioning the Postwar Home"

Name_____

Address_____

City_____ State_____

Copyrighted material

the making of *Marlin* GUNS

Marlin brings to sportsmen, through this series of advertisements, interesting facts on gun-making—to enhance appreciation of fine sporting firearms and to encourage their thoughtful handling and care.

BARREL-MAKING...A FINE ART • The barrel gives rifle and shotgun their accuracy. The steel used, the science and skill with which the barrel is made vitally affect the life and safety of the firearm as well. Barrel-making is a fine art of manufacture.

Rifling a Marlin Barrel

STEEL • Special-analysis steel, developed by metallurgical engineers to withstand proof loads 150% of normal pressure is the "raw material" of a Marlin barrel.

BORING • The solid steel bar is bored with special cutting tools.

TURNING • Cut to length, the special steel bar is turned on a lathe to proper diameter. A continuous "taper" is turned on rifle barrels to make for scientific strength distribution and "balance." The barrel is then highly polished and blued.

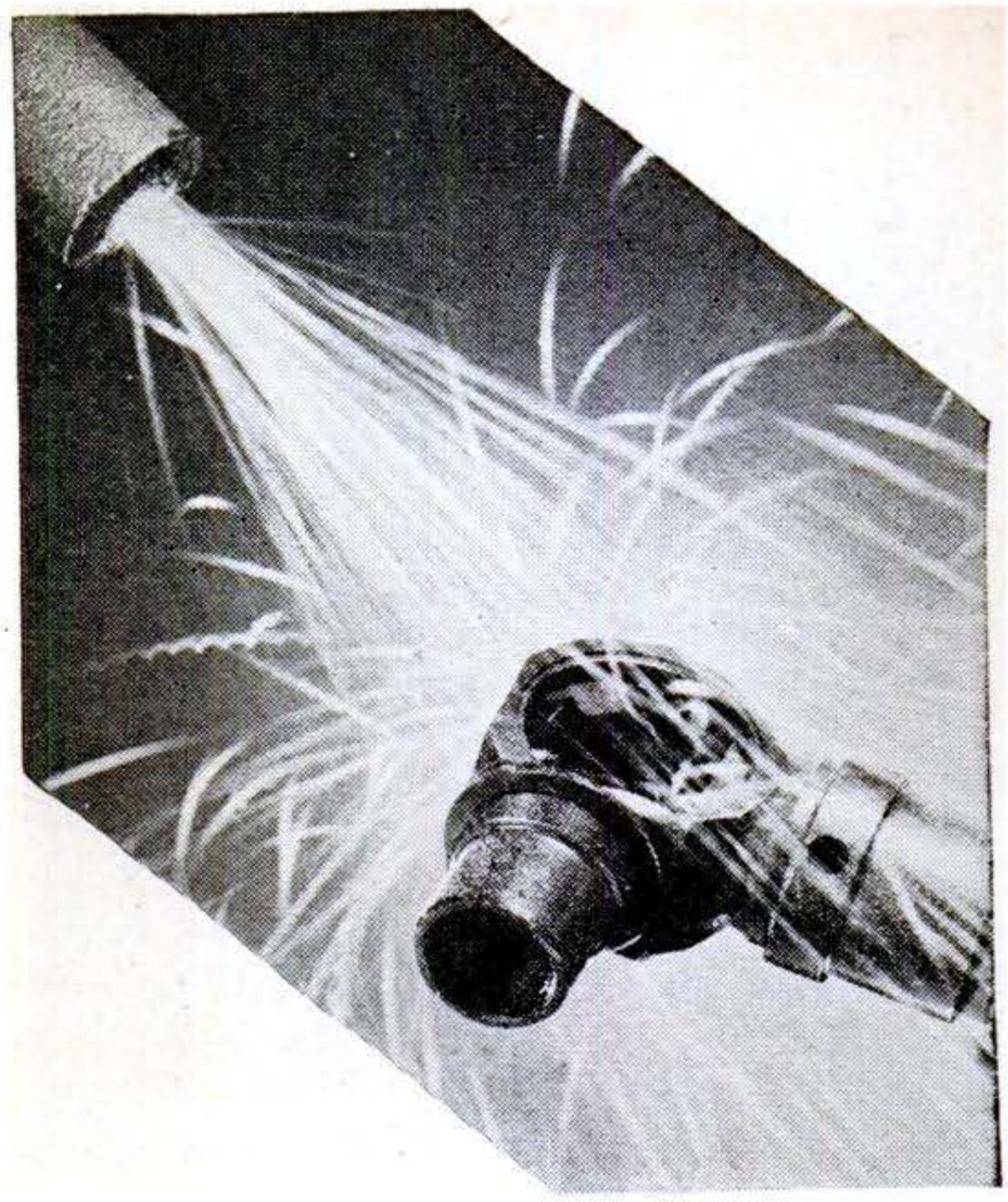
ALIGNMENT • The alignment of Marlin barrels touches a peak in the art of gun-making. Only one in hundreds of craftsmen has the "eye" for this delicate job. Marlin barrels are aligned at three distinct and separate times in the process of manufacture. Final alignment is the most exacting and gives the barrel its high potential of accuracy.

RIFLING • The Ballard rifling—which has long been a prime factor in the accuracy of Marlin Rifles—is done with specially-designed cutting tools. This operation is in charge of highly-skilled, experienced craftsmen.

(The next advertisement in this Marlin series will reveal more interesting facts on fine gun-making.)

THE *Marlin* FIREARMS CO.
New Haven, Conn.

SEE MARLIN 1946 MODELS ON DISPLAY AT YOUR DEALER'S

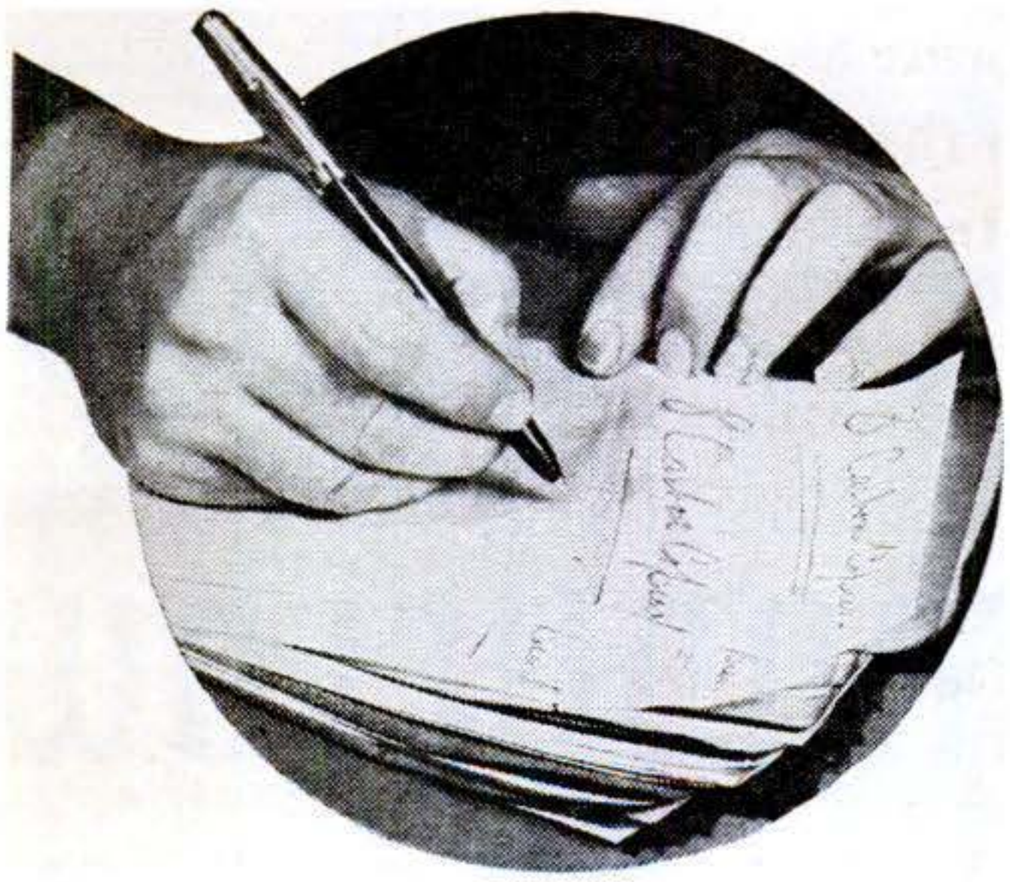


Pellets Clean Optical Tools

TENITE pellets, of the kind that have been used in the blasting of carbon from airplane pistons, are now used to remove the oxide surface smut that forms on optical-instrument parts. The minute plastic "bullets," blown from an ordinary blasting machine, draw out the dust and impart a satiny finish to the metal without abrasion.

Pen Writes 32 Miles Nonstop

THE new Reynolds pen, guaranteed to write for two years without refilling, in tests has inscribed a line 32 miles long. It uses a ball bearing, tooled down to a tolerance of 1/10,000 of an inch, as the writing agent instead of the conventional pen point. The ink is as viscid as heavy oil.



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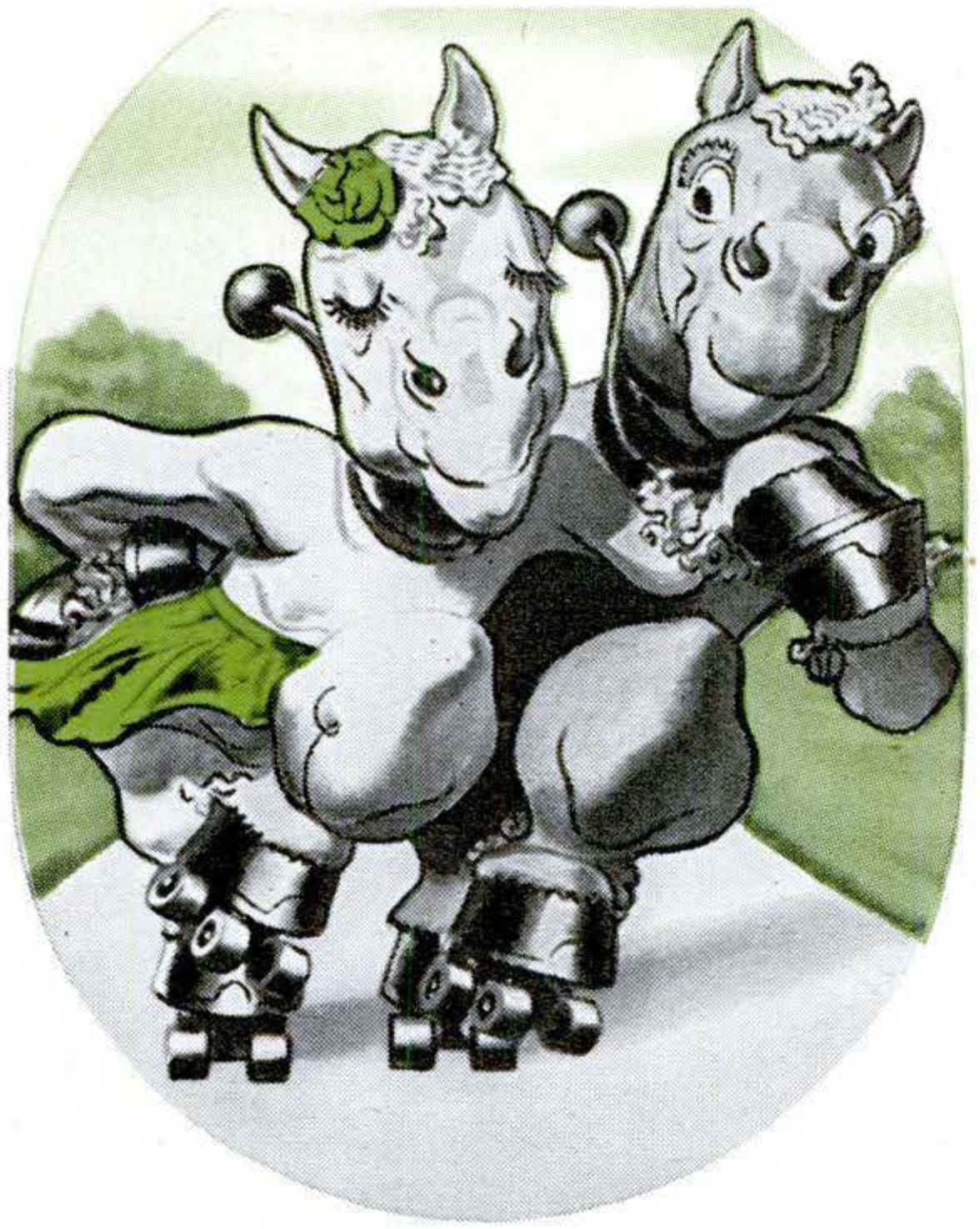
Smooth HORSEPOWER



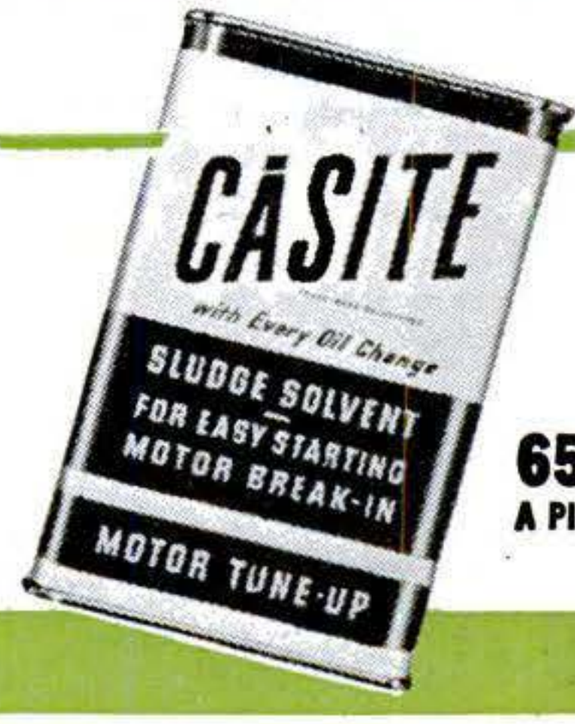
CASITE GUARANTEES BETTER AND SMOOTHER PERFORMANCE OR DOUBLE-YOUR-MONEY-BACK

Keeps new motors clean and powerful—brings new life to old motors. That's Casite! • In a new motor, Casite assures proper break-in . . . carries oil quickly to the tight spots . . . retards formation of sludge. • In an older motor, Casite gives a speedy tune-up . . . frees sticking valves and rings . . . reduces power-killing gum deposits . . . improves lubrication.

Put a pint of Casite in the crankcase every oil change and a pint through the air intake every three months. Sold by service stations, car dealers, garages, everywhere.

GUARANTEE

Add Casite to crankcase and run through air intake according to instructions, then drive your car 100 miles or for 60 days, whichever is first. If not convinced that Casite gives you better and smoother performance, you get double-your-money-back by filling out guarantee certificate and mailing it to The Casite Corp., Hastings, Mich. Maximum refund is $1.30 per pint, twice the advertised price of Casite.



65¢ A PINT

THE CASITE CORPORATION • HASTINGS, MICHIGAN

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It all adds up to one word . . .

● Eager power that flows smoothly, quietly at every speed . . . finger-touch handling ease, and starting sureness built right in . . . these, and every other quality you'd like in a motor, come right down to one word . . . *performance.*

And *performance* is what's waiting for you in every model of Evinrude's complete 1946 line. *Performance* that has been perfected step by step during 36 years of building fine outboard motors. *Performance you can bank on!*

See your Evinrude dealer soon — and send for free catalog of the complete Evinrude line.

Write for it today! Address, EVINRUDE MOTORS, 5188 N. 27th St., Milwaukee 9, Wis.

EVINRUDE

OUTBOARD MOTORS

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look SHARP

feel SHARP

be SHARP

use Gillette Blue Blades

with the **SHARPEST** *edges ever honed!*

You look SHARP because you get the best-looking shaves any man ever had!

You feel SHARP because Gillette Blue Blades give you the quickest, most refreshing shaves of your life!

You are SHARP when you buy Gillette Blue Blades with the SHARPEST edges ever honed, because you get more shaves per blade and save money!

Copr. 1946 Gillette Safety Razor Co

GILLETTE'S CAVALCADE OF SPORTS presents the major boxing event of the week every Friday night over American Broadcasting Company stations at 10 o'clock E.S.T.

Gillette Safety Razor Company, Boston 6, Mass.

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Cracked Engine?

TAKE IT EASY: That's nothing to worry about these days!

Right! When your service man speaks lightly of cracked engine heads and blocks—relax! It's a sure sign he stands ready to serve you quickly and economically with

K&W METALLIC SEAL MECHANICAL METHOD

—two war-proved methods that restore cracked engines to unimpaired service. Imagine—heads and blocks once consigned to the junk heap are easily repaired at an amazing low cost! 85% of all repairs are made in only 30 minutes with one can of K & W Metallic Seal—the other 15%, of unusually serious nature, are repaired in a matter of hours the Mechanical Method way.

For years, K & W Metallic Seal and Mechanical Method repairs have been standard practice among leading engine rebuilders, fleet operators, railroads and military repair centers. Today, these amazing time and money saving services are available to car owners at better service shops everywhere. *Remember—all K&W repairs are guaranteed for the life of the engine!*

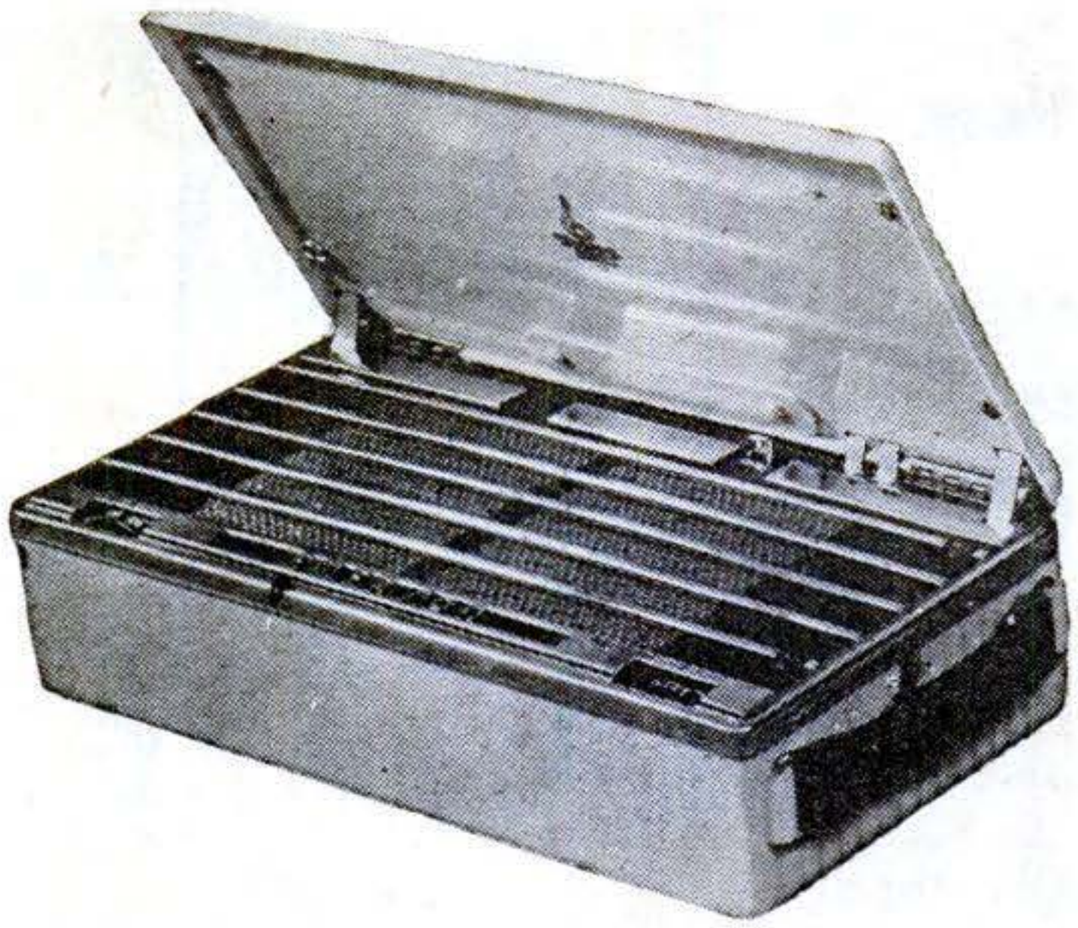
INVESTIGATE K&W GUARANTEED PRODUCTS FOR BETTER CAR SERVICE

Want finer car performance, appearance? Ask for these K&W products: Knock 'Er Loose (fast-acting penetrating compound), Radiator and Block Cleaner, Chrome Cleaner, Rust Inhibitor and Radiator Seal.

If you cannot locate a K & W Mechanical Method Shop, wire or write Kerkling & Company, Bloomington, Indiana, for names of those nearest you.

Mechanized Manicures

HAND care becomes automatic with the Abar Mfg. Co.'s Beautiator. Housed in a beetle plastic case is an electric motor that operates tools for disc filing, cuticle rolling and whisking, nail buffing, and oil massaging not only of the finger tips but of all the joints to the wrist.



Pocket Radio Has Plastic Case

SMALL enough to be carried in a coat pocket, yet powerful enough to be enjoyed by a whole party, is the Emerson radio above. It is self-powered and simple to play. Lifting the lid turns it on. The lightweight, virtually unbreakable Tenite plastic case gives excellent protection to the batteries, speaker, dials, and other parts that are compactly stored in a minimum of space.

Copyrighted material

RCA Laboratories provides another great achievement in television—the "mirror-backed" Kinescope, or picture tube.

New "searchlight brilliance" for home television!

Now, large screen television pictures are twice as bright—yes, *twice as bright* as ever before!

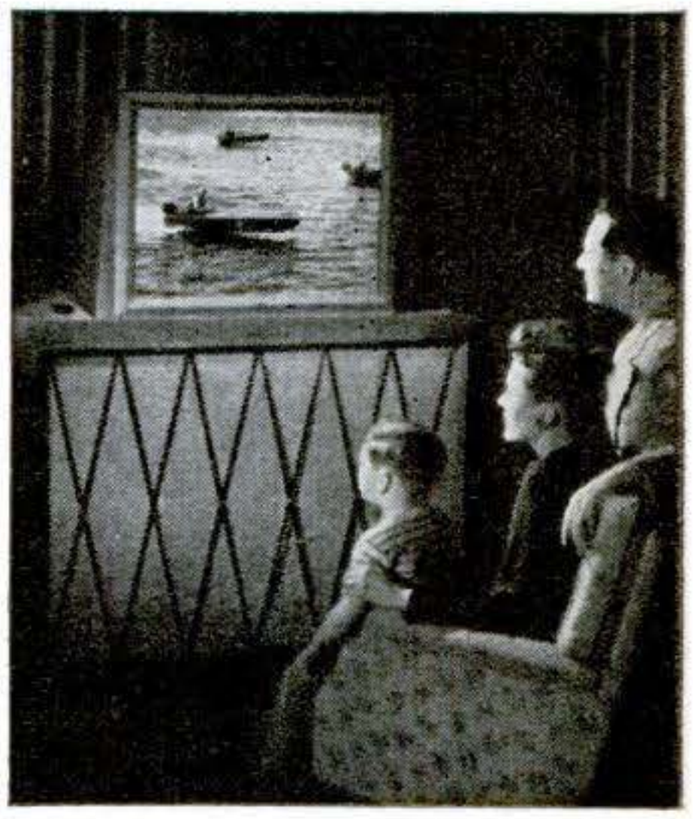
This new sharpness and brilliance is achieved through the new RCA "mirror-backed" Kinescope, or picture tube, perfected at RCA Laboratories.

It has a metallic film—eight-millionths of an inch thick. This metallic film acts as a reflector, allowing electrons to pass through to the screen but preventing light rays from becoming lost through the back of the tube. Just as the reflector of a searchlight concentrates its beam—so does this metallic film reflector double the brilliance and clarity of detail in home television receivers.

Similar progress-making research at RCA Laboratories is being applied constantly to all RCA Victor products—assuring you that anything you buy bearing the RCA monogram is one of the finest instruments of its kind science has achieved.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20. Listen to The RCA Victor Show, Sundays, 4:30 P.M., Eastern Time, over the NBC Network.



RCA Victor home television receivers will be available in two types. One model will have a direct-viewing screen about 6 by 8 inches. The other type will be similar to the set shown above—with a screen about 15 by 20 inches. Both instruments are being readied for the public with all possible speed and should be available this year.

RADIO CORPORATION of AMERICA

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"WE'RE GOING TO SEE OUR COUNTRY from the saddle of a HARLEY-DAVIDSON"

"We want to tour all sections of the good old U. S. A. on new Harley-Davidsons!" That's what thousands of Harley-Davidson fans told us during the war, in letters which poured in from all over the country and the world. Now, the new Harley-Davidsons are rolling off the production line in ever-increasing numbers — the beauty and fun spots of America are waiting for your coming! See your Harley-Davidson Motorcycle dealer EARLY — and get set to make the most of the glorious touring months that are ahead!

HARLEY-DAVIDSON *Motorcycles*

HARLEY-DAVIDSON MOTOR CO., Dept. PS, Milwaukee 1, Wisconsin

Please send at once free copy of 24-page "ENTHUSIAST" Magazine, filled with motorcycle action pictures and touring stories.

Name.....

Address.....

City.....*State*.....

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For better results 26 Basic Ring Designs

No one piston ring design can meet all replacement needs. Sealed Power Individually Engineered Ring Sets are made up from twenty-six (26) basic ring designs, which permit each set to be specifically engineered to do the best possible job in a particular make of engine.

These ring sets are engineered to save gas without sacrifice of oil economy, to save oil without inducing friction and cylinder wear. Each set gives *balanced* performance in a particular engine.

Cars shouldn't smoke, either!

SMOKE from a car means burning oil, wasted power, cumulative damage to cylinder walls. All these can be cured by reconditioning the engine and installing new Sealed Power Piston Rings. They lengthen engine life, restore original power, save oil, save gas.

Whatever the make, model, or degree of cylinder wear in your engine, there's a Sealed Power Ring Set specifically engineered to do the best possible job. Sealed Power people are proud of their product and its 34-year record of preference by leading car, truck and engine builders. Ask your favorite repairman to install a Sealed Power Individually Engineered Ring Set in your car now! Sealed Power Corporation, Muskegon, Michigan and Stratford, Ontario.

Piston Rings
Pistons
Cylinder Sleeves
Valves
Water Pumps
Chassis Parts

KEEP YOUR WAR BONDS! GET $4 FOR $3!

© 1946, Sealed Power Corp.

SEALED POWER PISTON RINGS

BEST IN NEW CARS! ★ BEST IN OLD CARS!

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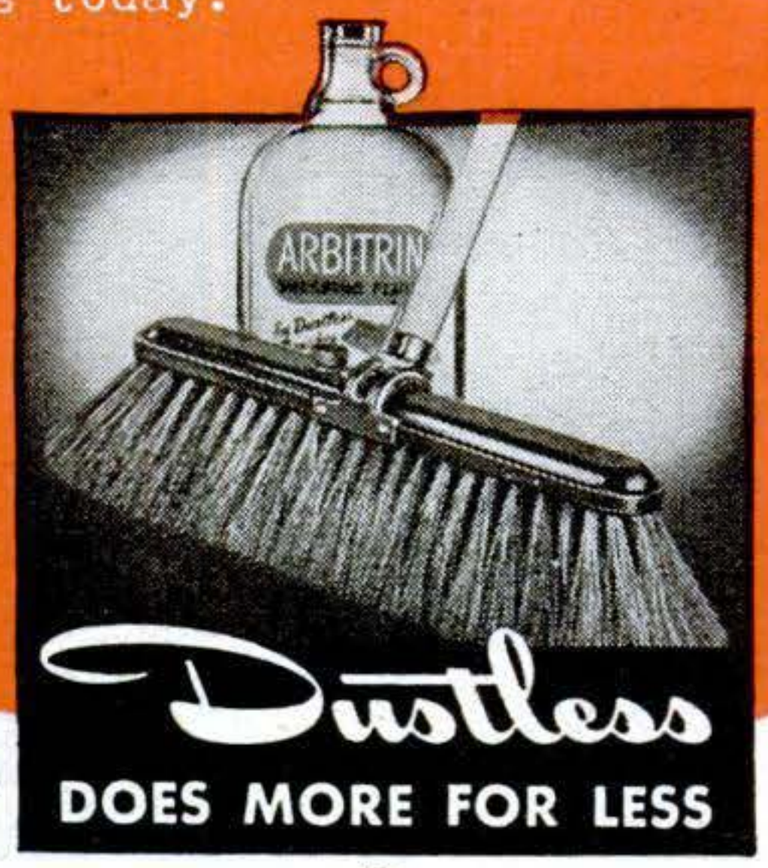
NO MORE SWEEPING COMPOUND

Sweeping the modern "Dustless" way forever eliminates sweeping compound. Here's why: As you sweep with a Dustless brush, Arbitrin sweeping fluid, fed from a reservoir in the back of the brush, moistens the dust. Instead of rising into the air, the dust itself is converted into a sweeping compound that sweeps many times cleaner and safer than any commercially prepared sweeping compound at any price. Thousands of factories, shops, offices, and schools have adopted this "Dustless" method of sweeping. You ought to know more about it. Write for complete facts today.



MD

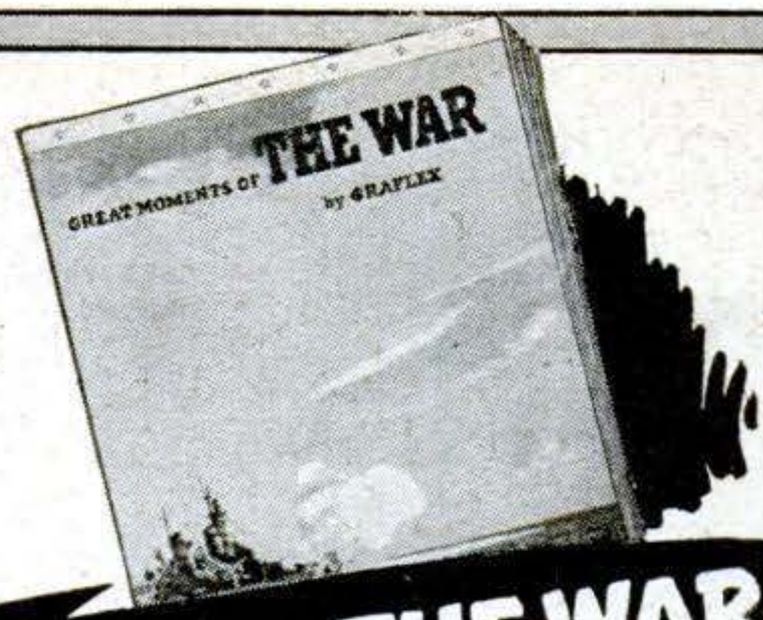
- Dustless
- Speed Sweep
- Speed Wash brushes

Dustless

DOES MORE FOR LESS

MILWAUKEE DUSTLESS BRUSH COMPANY

528 N. 22nd Street • Milwaukee 3, Wisconsin



Great Moments of THE WAR! — by Graflex

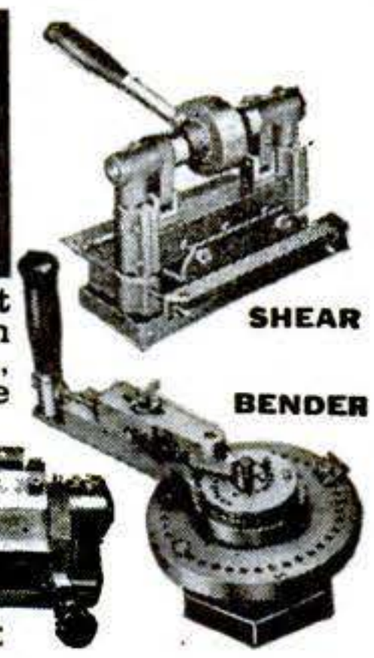
FREE! An action-packed camera record of the War in Europe, Africa, and the Pacific! Combat cameramen from all the Services took these dramatic pictures of our men and weapons in action! Get a FREE copy from your local GRAFLEX Dealer, or send 10¢, to cover handling, to Room 42, GRAFLEX, Inc., Rochester 8, New York. (Formerly The Folmer Graflex Corporation)

VISIT Graflex Information Centers — At 50 Rockefeller Plaza, New York, N. Y. and 3045 Wilshire Blvd., Los Angeles, Calif.

GRAFLEX

gets great pictures!

DIE-LESS DUPLICATING



Many small parts can be formed without dies, to duplicated accuracy of .001" with DI-ACRO Precision Machines, — Benders, Brakes, Shears. Save die expense and time delay. Ideal for experimental and research work, making samples, models, etc. as well as regular production runs. **Write for descriptive literature.**

O'NEIL-IRWIN MFG. COMPANY

342 8th Ave. South, Minneapolis 15, Minn.

Thompson BEATS the World on BOATS

Better Built Lower Prices

Safe Boats With Full Length Spray Rails

Keep passengers perfectly dry—even at high speeds. Catalog also shows two new models of "Take-Along" Boats. Two big factories—save you freight.

CATALOG FREE

Write for your copy. State kind of boat in which you are interested.

THOMPSON BROS. BOAT MFG. CO. (151)

219 Ann St. PESHTIGO, WIS. — (*Write to either place*) — 119 Elm St. CORTLAND, N.Y.

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Have Fun and Win Popularity
THROUGH MUSIC!

Don't envy the fellow who plays an instrument ... You, too, can be popular and have fun *making music!* You can entertain others ... be the "life of the party." Playing a wind instrument is *easy* ... and *it's a lot more fun than just listening!* Anyone who can whistle a tune can play a new Conn. The fingering is simple and the scale comes easily because of exclusive, patented Conn features and advanced design. *Get all the thrilling details.* See for yourself how *you* can have fun and win popularity through music. See your friendly Conn dealer, or write direct to Conn for FREE copies of the profusely illustrated, interesting books shown at right. Do it today.

C. G. CONN LTD., Elkhart, Indiana. 1914

Write... FOR FREE BOOKS

TEEN-AGERS—Ask for "Fun and Popularity Through Music." Ideas and examples of how *you* can enjoy advantages and opportunities which playing a wind instrument provides.

PARENTS—Ask for "Music, The Emotional Outlet for Youth." An important guide in rearing children that is widely acclaimed by authorities on youth problems.

C. G. CONN LTD.,
332 Conn Building, Elkhart, Indiana.
Without obligation, please send FREE Book checked below.

☐ *"Fun and Popularity Through Music"*
☐ *"Music, The Emotional Outlet for Youth"*

NAME_____

ADDRESS_____

CITY_____ ZONE____ STATE_____

WORLD'S LARGEST MANUFACTURERS OF BAND INSTRUMENTS

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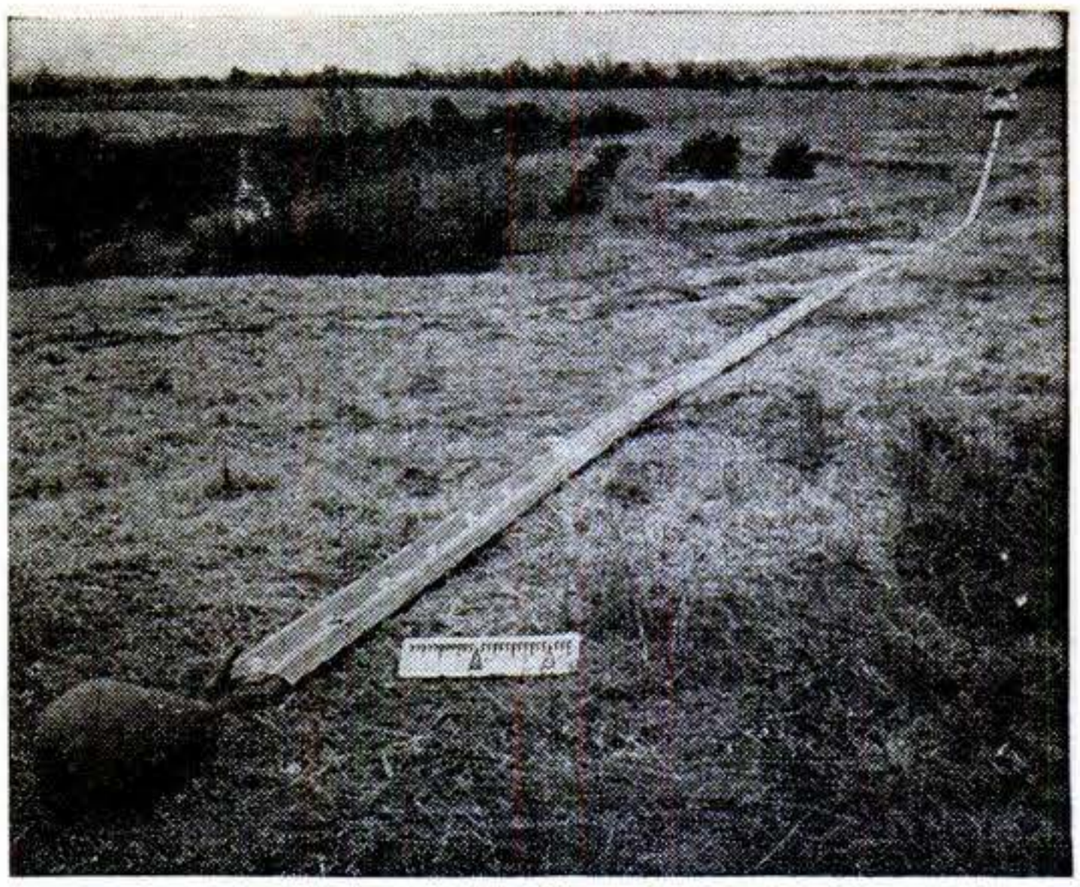
MILLERS FALLS TOOLS
SINCE 1868

One thing in common — QUALITY!

There are hundreds of Millers Falls Tools for thousands of jobs. . . . From the simplest screw driver to the finest precision tool, they have one thing in common — QUALITY. Experienced craftsmen of the past took pride in the unvarying quality of Millers Falls tools. Countless thousands of new craftsmen now depend upon them. Your dealer's supply of Millers Falls Tools is increasing in size and variety. Ask him or write for complete details.

MILLERS FALLS COMPANY
Greenfield • Massachusetts



"Snakes" Blasted Tank Path

"THE Snake," pictured above, was used in the European Theater to cut wires and detonate enemy mines ahead of advancing Allied forces, clearing a trail wide enough for a line of tanks. This ground-hugging weapon is a long metal trough, loaded with two parallel linear explosive charges encased between corrugated aluminum plates, bolted together to form a rigid assembly that can be towed or pushed by a light or medium tank. It is 400 feet long, 14 inches wide, five inches high, and weighs about 9,000 pounds including 4,480 pounds of high explosives. A pear-shaped, flexible nose (lower left in photo) guides it over rocks, around trees. "Snakes" are exploded by machine-gun fire from the propelling tank.

Postal Employees Will Be Rewarded for Bright Ideas

A NEW Federal law authorizes the Postmaster General to offer anything up to $1,000 to any postal employee in return for a top-grade invention, suggestion, or series of suggestions. The idea must promote economy or increase efficiency so well that it is adopted by the Post Office Department. As presently understood, there will be no time limit for the "contest," but the total amount of rewards made under the act must not exceed $25,000 in any one year. Further rules and regulations are to be worked out under the direction of the Postmaster General.

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"Switch to Auto-Lite Spark Plugs"

DICK HAYMES

"They make sweet music in any engine"

HELEN FORREST

"Ignition Engineering helps give economy, too"

GORDON JENKINS

Tune in the Dick Haymes Show with Helen Forrest • Gordon Jenkins' Orchestra and Chorus • Saturdays, 8:00 P.M.—E.S.T. on CBS

Money cannot buy a better Spark Plug *

AUTO-LITE spark plugs are designed by the same engineers who design complete electrical systems for leading cars and trucks. This specialized engineering experience is one reason why money cannot buy a better spark plug. A complete set of ignition engineered Auto-Lite spark plugs in your car, helps give you quick starts and full mileage from every gallon of gas. So switch to Auto-Lite when faulty spark plugs need replacing. See your friendly Auto-Lite Spark Plug Dealer today.

AUTO-LITE MEANS PRECISION MANUFACTURING

THE ELECTRIC AUTO-LITE COMPANY
Toronto 1, Ontario — Toledo 1, Ohio

AUTO-LITE SPARK PLUGS
"Ignition Engineered"

Copyrighted material

for that Professional
FINISH . . .
use PLASTIC WOOD

in your HOME WORKSHOP!

- **PLASTIC WOOD** is the most versatile material for the wood working hobbyist . . . Not only can you do many things with **PLASTIC WOOD,** such as special moldings, decorative effects in relief, and strengthened joints, but you can cover any mistakes or fill in knot holes for a perfect surface.
- **PLASTIC WOOD** can be carved, sanded, planed, sawed, drilled, or nailed . . . and it won't split, crack or chip.

PLASTIC WOOD is an all purpose material for any wood working shop. Sold in cans or tubes in all hardware, paint, and 10¢ stores.

Did you ever use **PLASTIC WOOD** *for dowel pins?*

PLASTIC WOOD
A CELLULOSE FIBRE FILLER

Talented Science Students Compete for $11,000 Awards

FORTY high school seniors who are outstanding students in science are in Washington this month attending the five-day Science Talent Institute and competing for $11,000 in Westinghouse Science Scholarships. The fortunate 40, of whom 11 are girls, became finalists in an annual national competition conducted by Science Clubs of America by obtaining highest grades in a rigid science-aptitude examination. It was designed to determine creative ability and measure capacity for thinking as well as to reveal scientific knowledge. The interests of the finalists, who come from 14 states and the District of Columbia, range from interplanetary flight to the effects of vitamins upon bacteria. Most of them revealed a scientific bent before they entered high school.

The $11,000 in scholarships, provided by the Westinghouse Educational Foundation in the interest of advancing science in America, will be distributed according to the recommendations of the judges, after they have had personal interviews with the contestants. Awards include four-year scholarships of $2,400 each to the top boy and girl, and eight four-year scholarships of $400 each. The remaining $3,000 will be distributed in additional scholarships at the discretion of the judges: Dr. Steuart Henderson Britt, New York psychologist; Dr. Harold A. Edgerton, director of the Occupational Opportunities Service at Ohio State University; and Dr. Harlow Shapley, director of the Harvard Observatory.

U. S. Gets Fossil Bones of Wolf That Lived 30,000,000 Years Ago

FOSSIL bones of a 30,000,000-year-old animal that looked like a wolf and lived like a wolf but really was more closely related to opossums and kangaroos recently were brought from Colombia to the University of California by Dr. R. A. Stirton. The collections were made by Dr. Stirton while he was doing research in South America as a Guggenheim fellow.

Correction

THE December 1945 issue of *Popular Science Monthly* stated (on page 218) that ordinary uranium contained four times as many U-238 atoms as U-235 atoms. This was a typographical error. Ordinary uranium contains 140 times as many U-238 atoms as U-235 atoms.

Copyrighted material

"GREASED LIGHTNING"

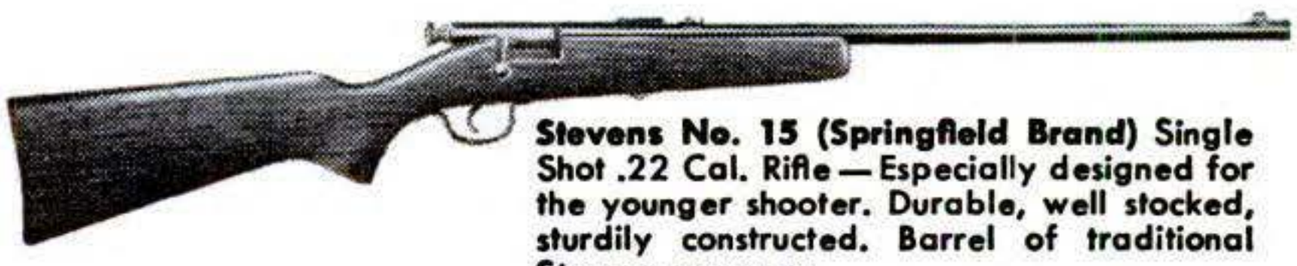
His first name is "speed" but he's s-l-o-w compared to the "greased lightning" packed into the trim, sleek lines of a Stevens .22 cal. Automatic. Here's a fine handling, fast shooting "auto-loader" with all the traditional accuracy, value and dependability of Stevens rifles and shotguns.

You'll want to own and shoot this great Stevens rifle. It opens up a new and exciting field of small bore rifle sport, including the thrills of "speed shooting" at small running game.

Your dealer has—or will have soon—*your* new Stevens .22 Automatic, as well as a selection of other popular Stevens models, including repeating and single shot bolt action rifles; repeating, double and single barrel shotguns and .22-.410 over-and-under combination guns. See them today.

J. STEVENS ARMS COMPANY, Chicopee Falls, Mass.
Division of Savage Arms Corporation

Stevens No. 87 (Springfield Brand) .22 cal. automatic rifle. 15 shots as fast as you can pull the trigger. One of a great line of Stevens-built ".22's."



Stevens No. 15 (Springfield Brand) Single Shot .22 Cal. Rifle—Especially designed for the younger shooter. Durable, well stocked, sturdily constructed. Barrel of traditional Stevens accuracy.

Stevens No. 22-410 "Over-and-Under"—combination rifle and shotgun. A Stevens pioneered "first." Over barrel: .22 l. r., .22 long or .22 short. Under barrel: .410 gauge, 2½ or 3 inch shells.

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NEW *and Ready for you*

ALLIED'S 1946 CATALOG

of Radio and Electronic Supplies

FREE
Send for it
NOW

BRINGS YOU LATEST, finest values in Radio! New receivers, phono-radios, Ham gear, parts, tubes, kits, code apparatus, tools, books, test instruments, public address—all types of equipment. Over 10,000 items. Leading makes. Guaranteed quality. Fastest service from the world's largest and most complete stocks under one roof. Send for your free copy of Allied's new 1946 Buying Guide now. *Save time and money.*

HELPFUL RADIO BOOKS

Radio Formulas & Data No. 37-752 . . . 10c
Dictionary of Radio Terms No. 37-751 . 10c
Radio Circuit Handbook No. 37-753 . . . 10c
Radio Builders' Handbook No. 37-750 . 10c
Simplified Radio Servicing No. 37-755 . 10c
Radio Data Handbook No. 37-754 . . . . 25c
ALL SIX BOOKS No. 37-799 . . . . . 75c
Parallel Resistance and Series Capacitance Calculator. No. X37-960 . . 25c

ALLIED RADIO

ALLIED RADIO CORP.
833 W. Jackson Blvd., Dept 7-CC-6
Chicago 7, Illinois

Date.....

☐ Send FREE 1946 CATALOG
☐ Send....Books/Calculator No.....($....enclosed)

Name.....

Address.....

City.....*Zone*.....*State*.....

OVER 75 MILES PER GAL!

Cushman MOTOR SCOOTER

For getting there Quick—Comfortably—and at Lowest Possible Cost, you can't beat the Cushman—and the new 1946 model is 'way ahead of anything you have ever seen!

POWER TO BURN! Rugged 4 H. P. engine with 2-speed transmission speeds you up steepest hills!

COSTS LITTLE! $1 worth of gas takes you 400 miles! Any speed up to 35 miles an hour!

TRULY COMFORTABLE! Long wheel base, improved spring action, big balloon tires, insure smooth riding!

Many 2-wheel or 3-wheel models—with or without side or front package-box for carrying big loads.

OTHER MODELS

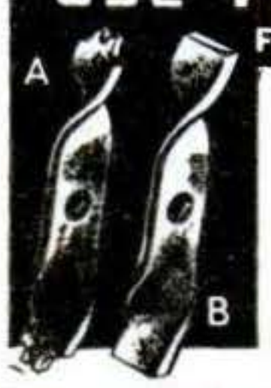
SIDE-KAR—3-wheels. Package-box carries 200-lbs.

PACKAGE-KAR — 3-wheels. Front package-box carries 250-lbs.

WRITE See your dealer or send for Free Folders, Prices.

CUSHMAN MOTOR WORKS
Dept. S-13, Lincoln, Nebr.

USE YOUR BENCH SAW
FOR JOINTING & CUTTING MOULDINGS



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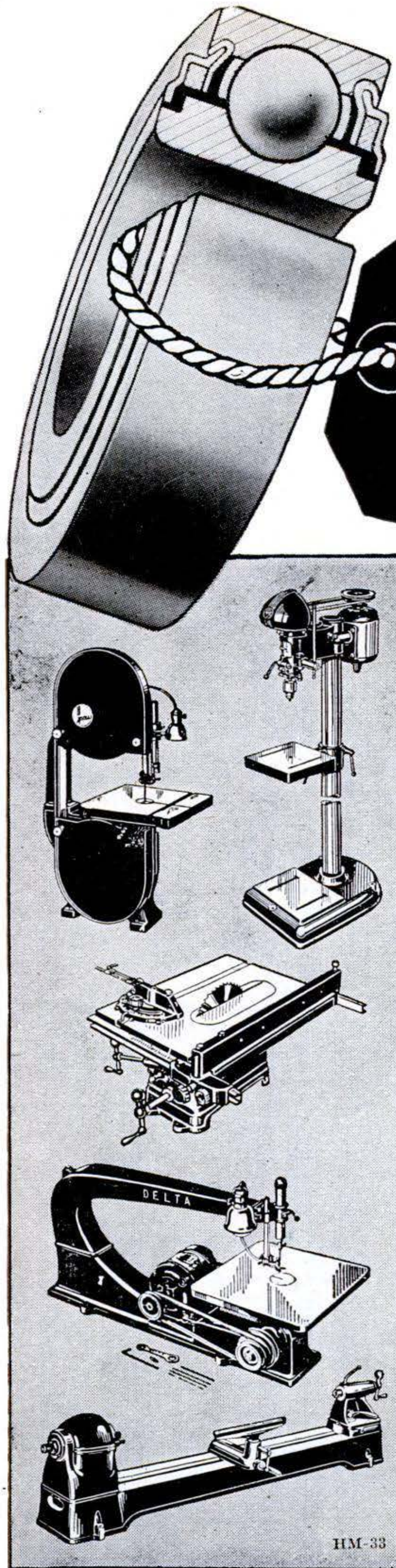

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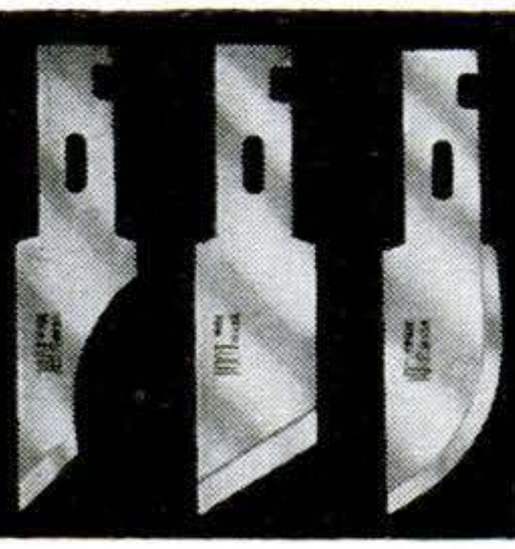

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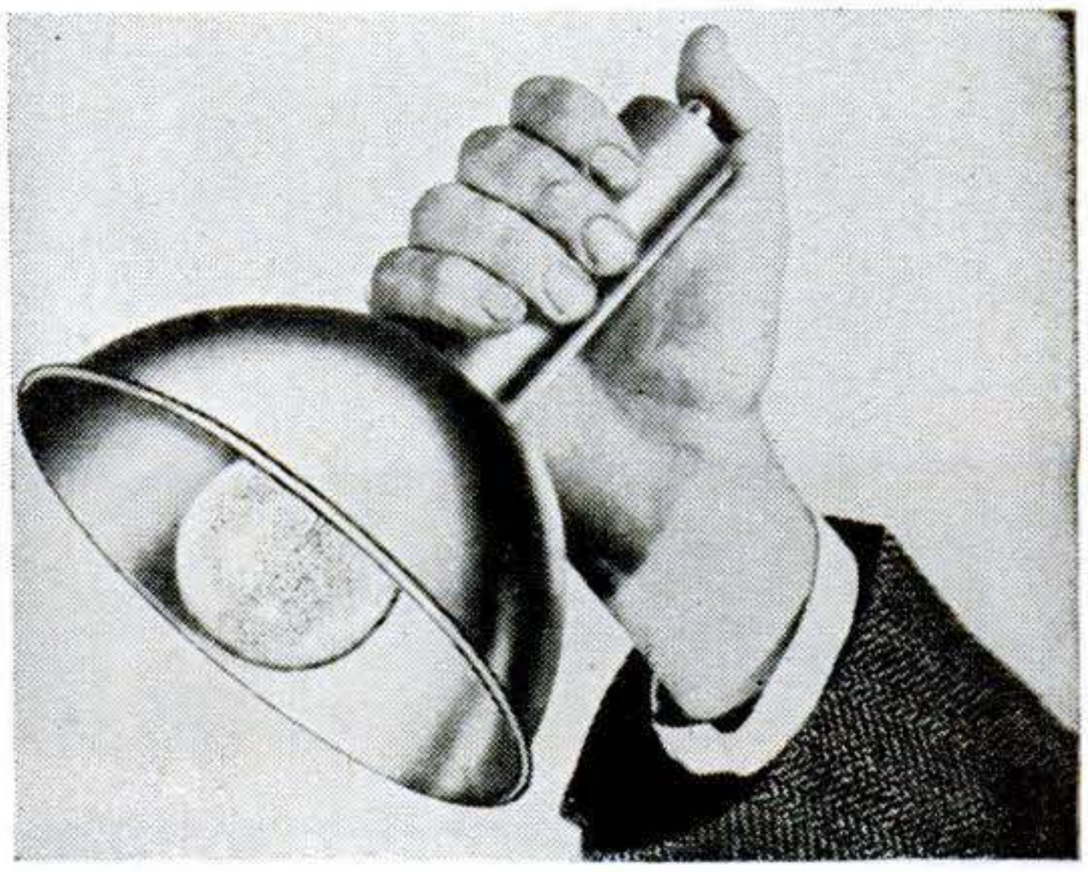
LIGHT from a new hand flash lamp is restricted to slightly more than usual camera-lens coverage by a deep reflector. The handle of this Aimrite lamp contains a single "D" cell. When the unit is held as shown below, the thumb is in position to press the switch. The Mendelsohn Speedgun Company, of Bloomfield, N. J., is the maker.



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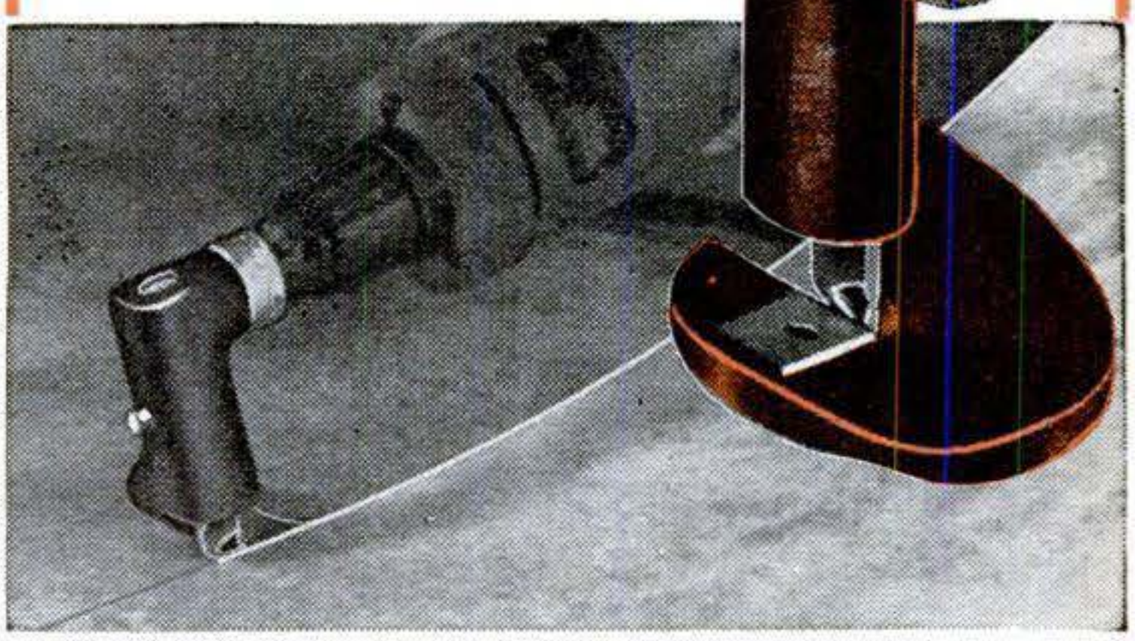

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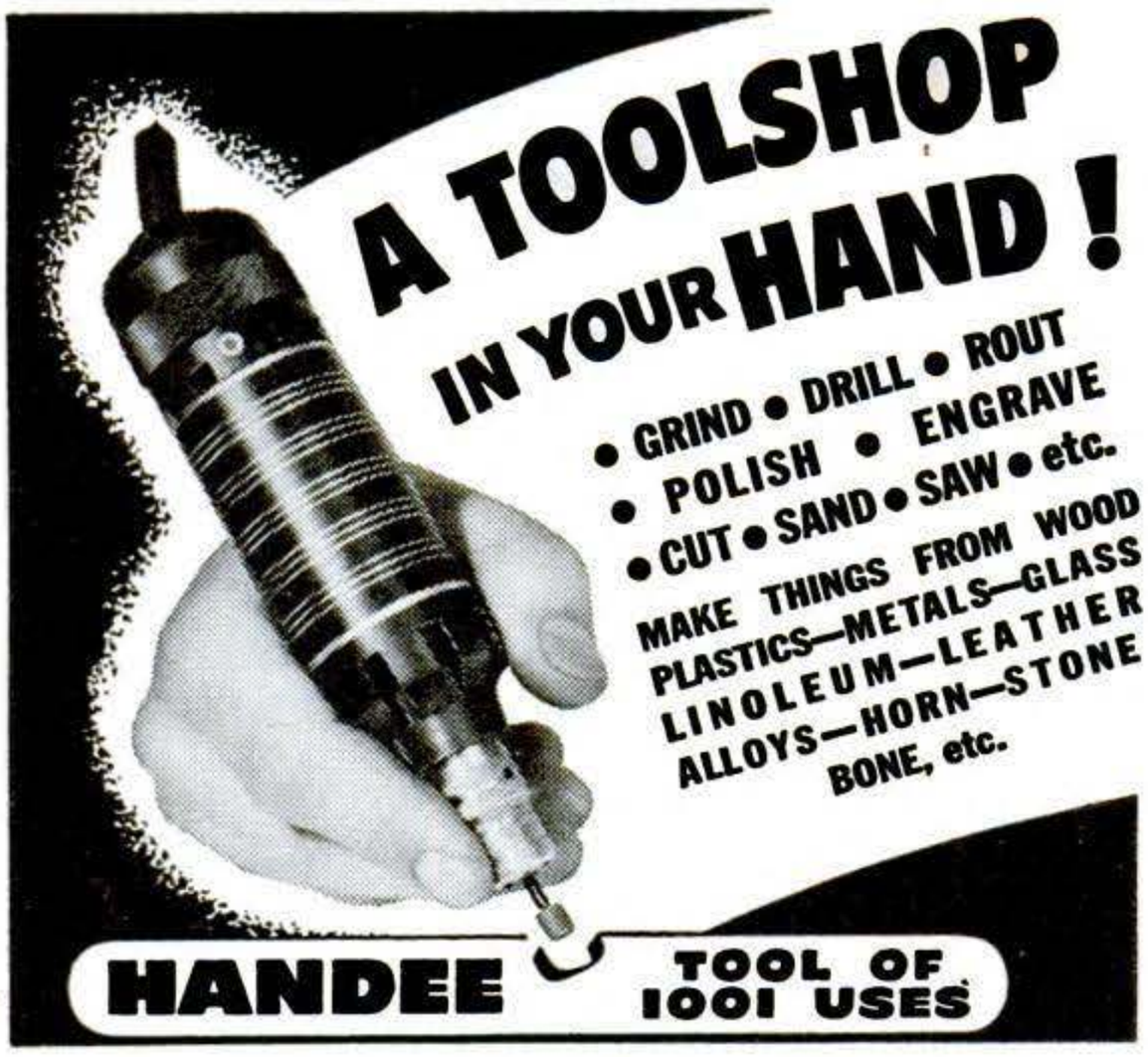

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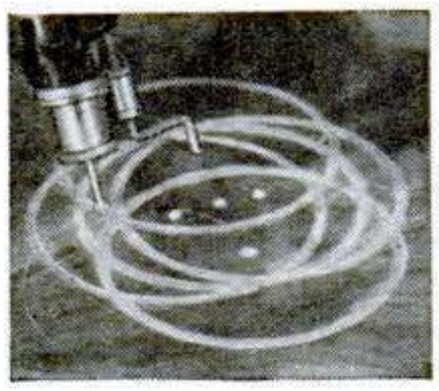

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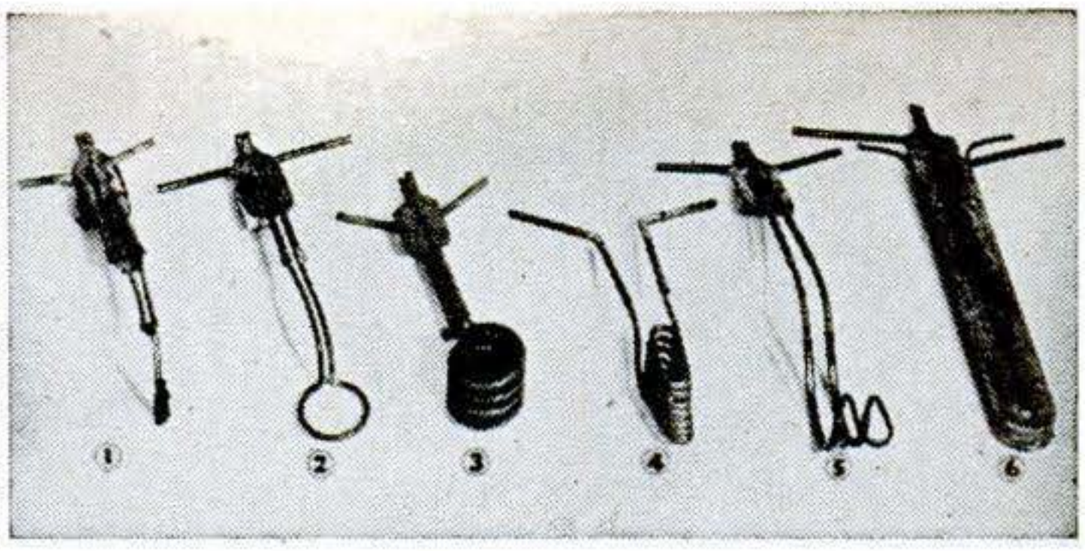

Inductors are readily interchanged for different jobs. Above are various types—internal (1 and 2), external (3 and 4), hairpin (5), and multiple (6).

New Induction-Brazing Method Speeds Production of Cars

SOME automobile parts that formerly were cast, forged or machined from solid stock now are being produced in sections and brazed together with induction heat and silver-base alloys or pure copper. The new process not only speeds up production but often yields a harder and stronger part.

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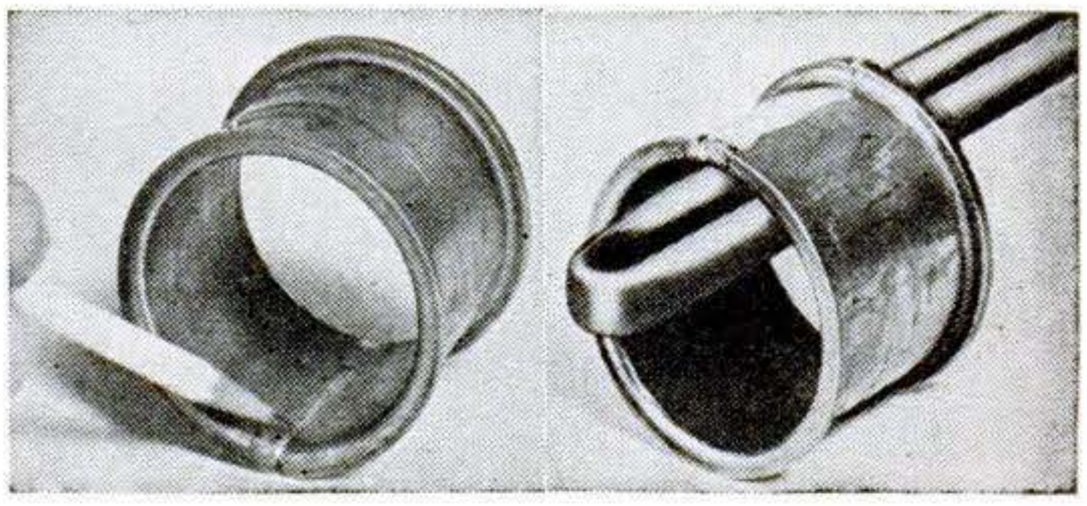
Inductors used in the process were developed during the war years. These are coils of copper tubing through which water runs to keep them cool. For different jobs, the inductors may be interchanged as easily as plugging a lamp into a socket.

The internal inductors above (1 and 2) are used to anneal part of a surface already hardened, the external (3 and 4) are designed for rod and flat stock, the hairpin type (5) for hardening grooves in a twin-groove pulley; and the multiple coil (6) for hardening simultaneously the threaded portion of 10 bolts.—CHARLES T. PEARSON.

A loop of copper tubing provides the heat to braze this bearing. The joint requires very little alloy.



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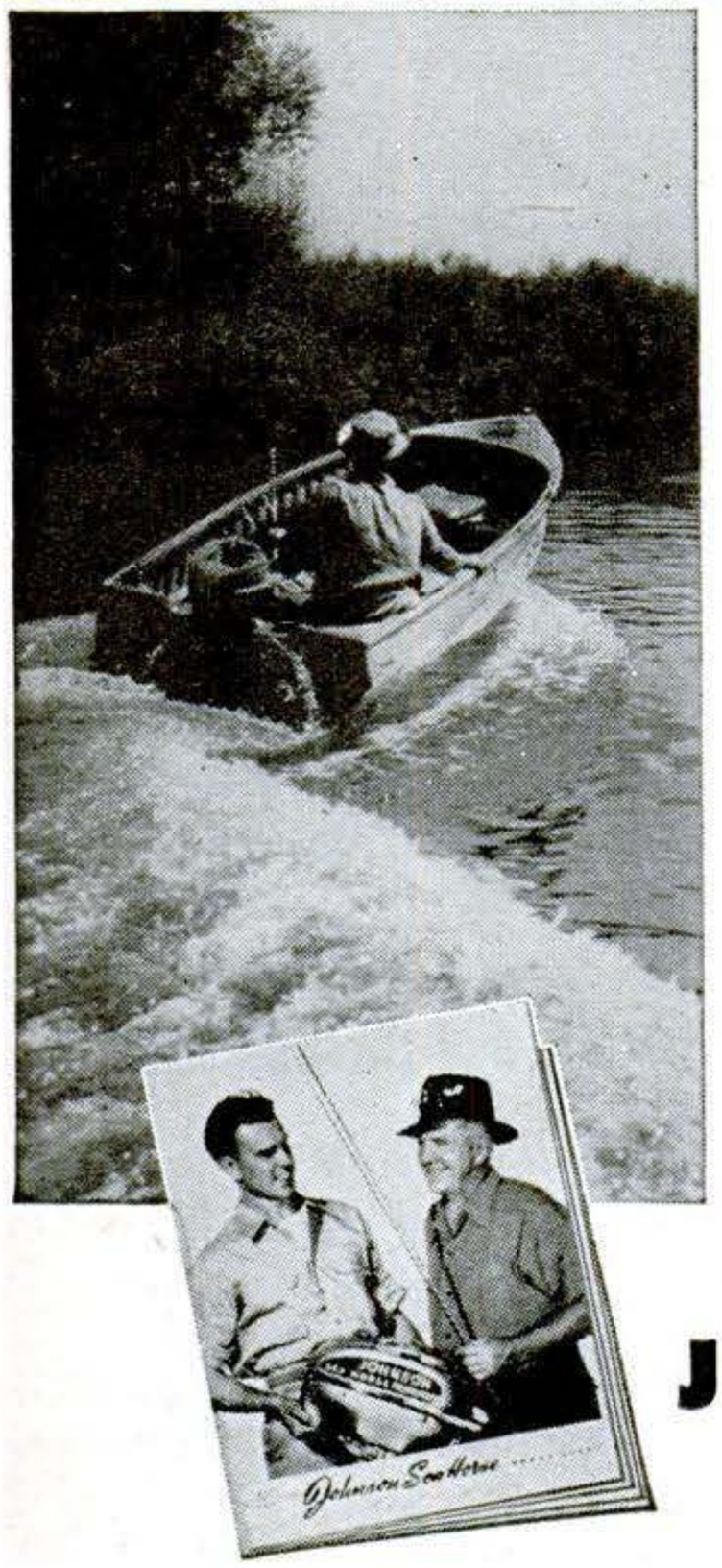

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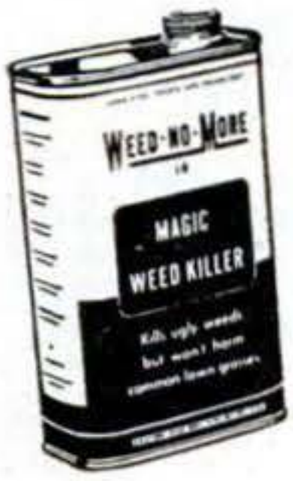

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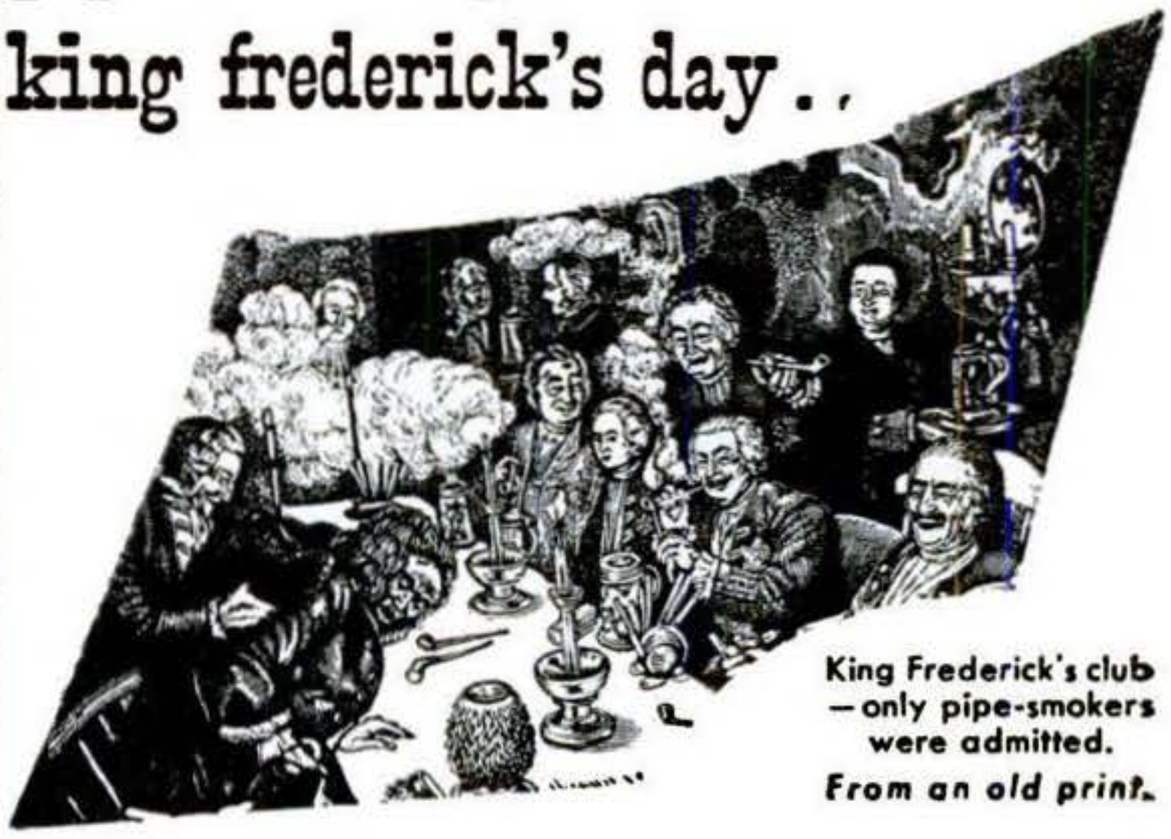
pipe-smoking in king frederick's day . .



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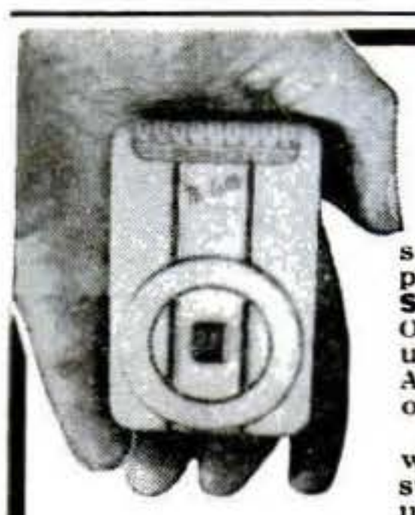

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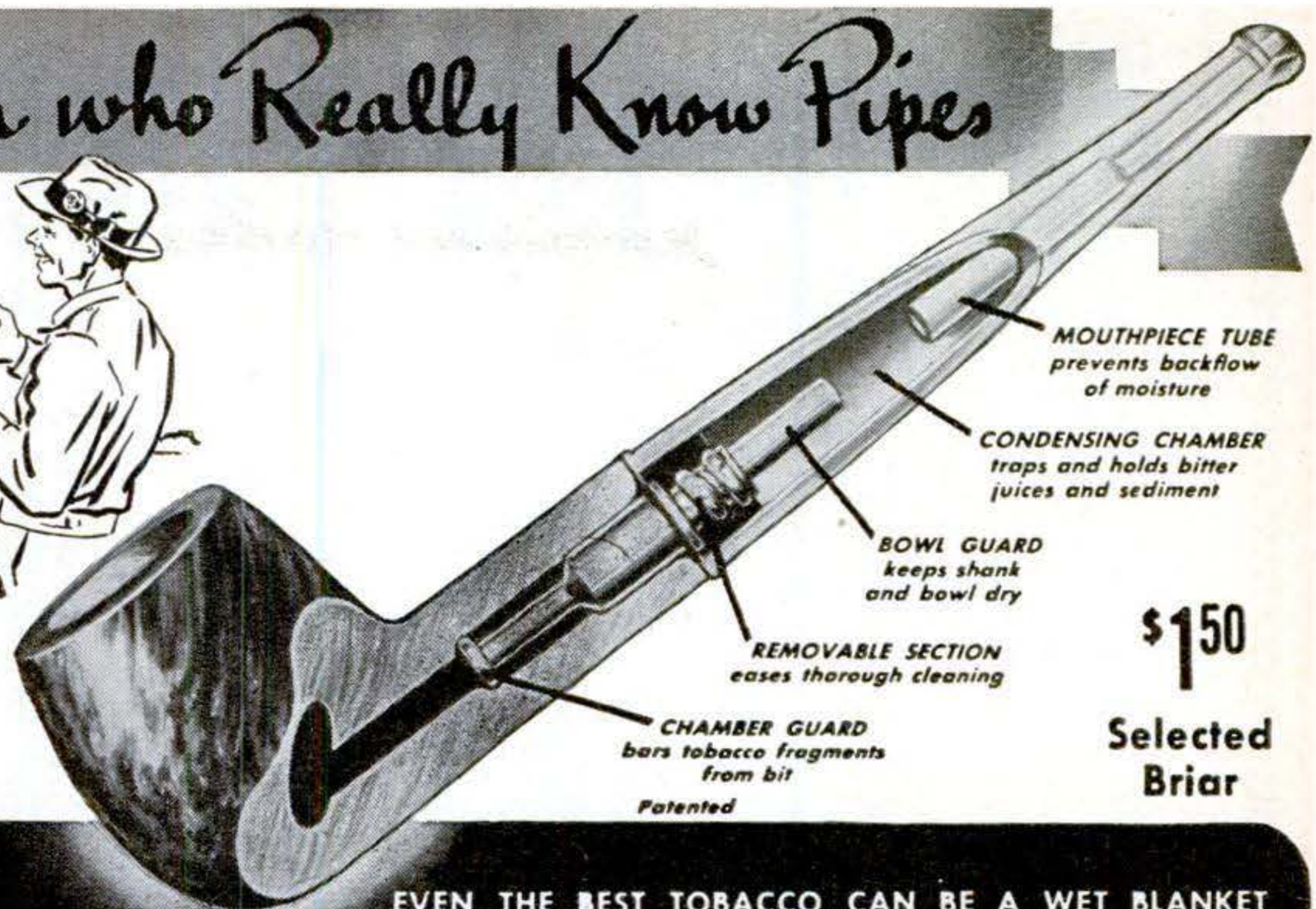

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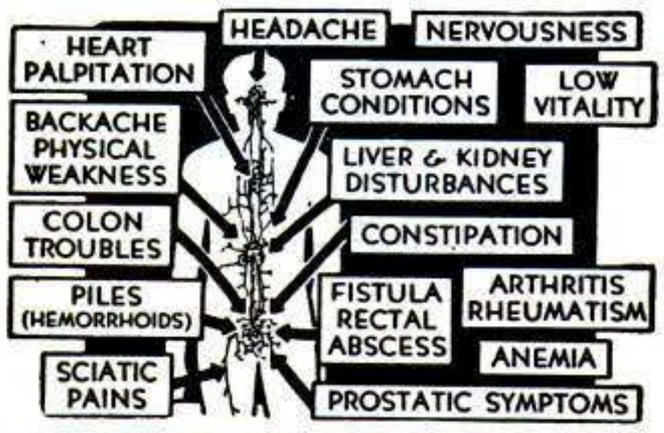

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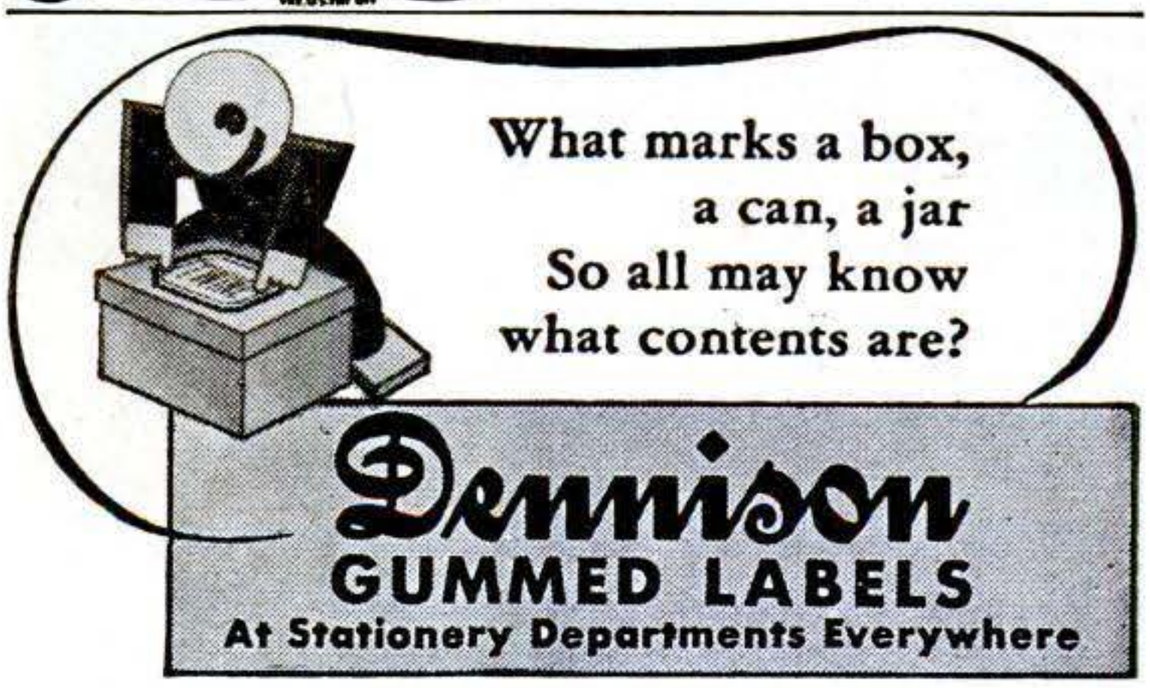

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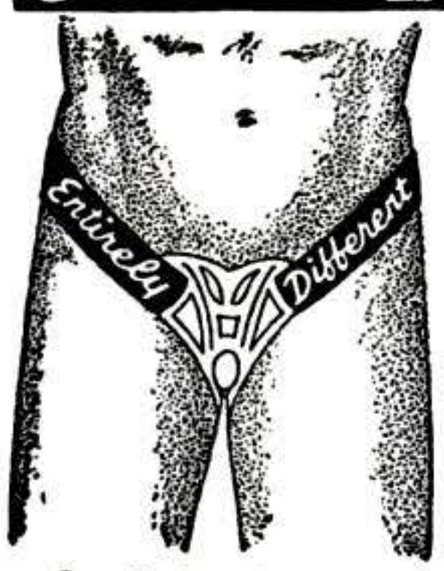

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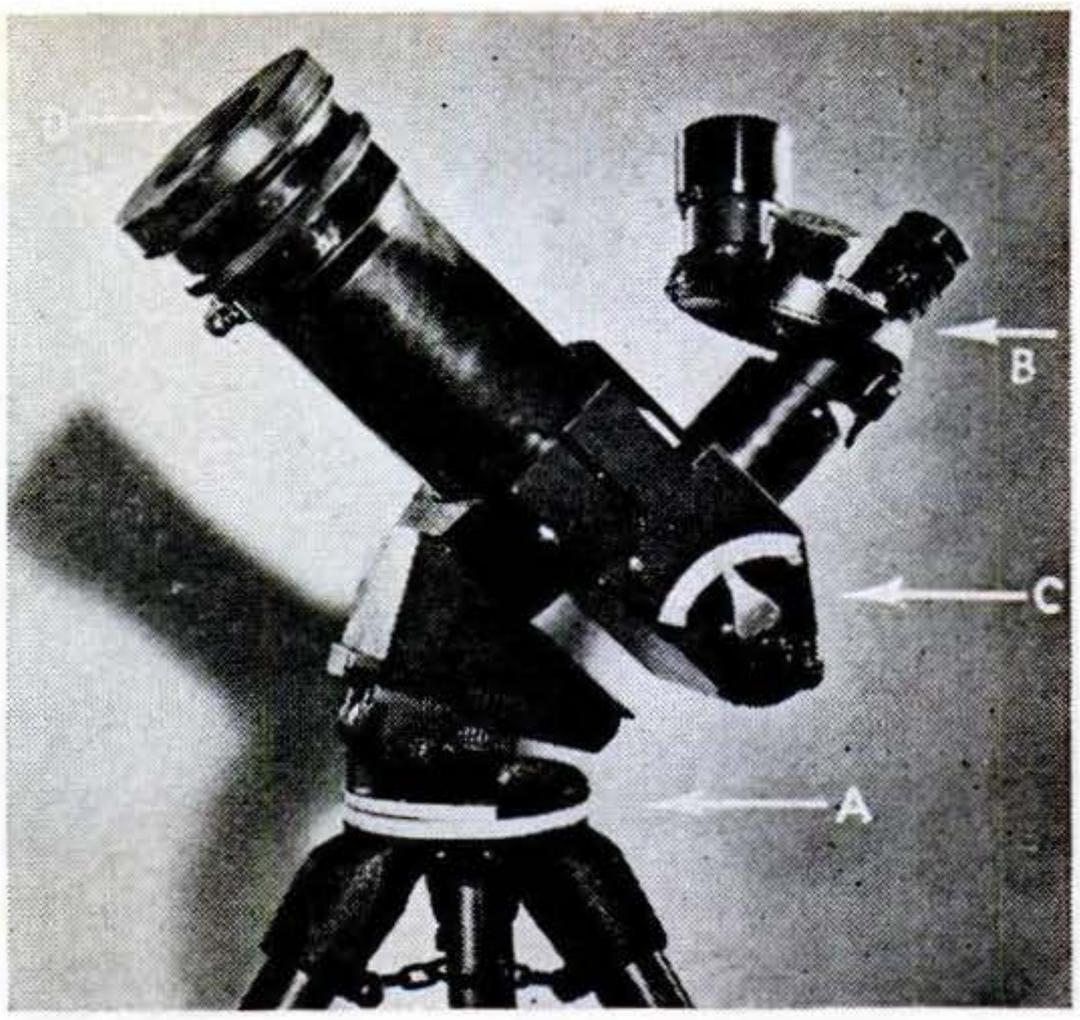

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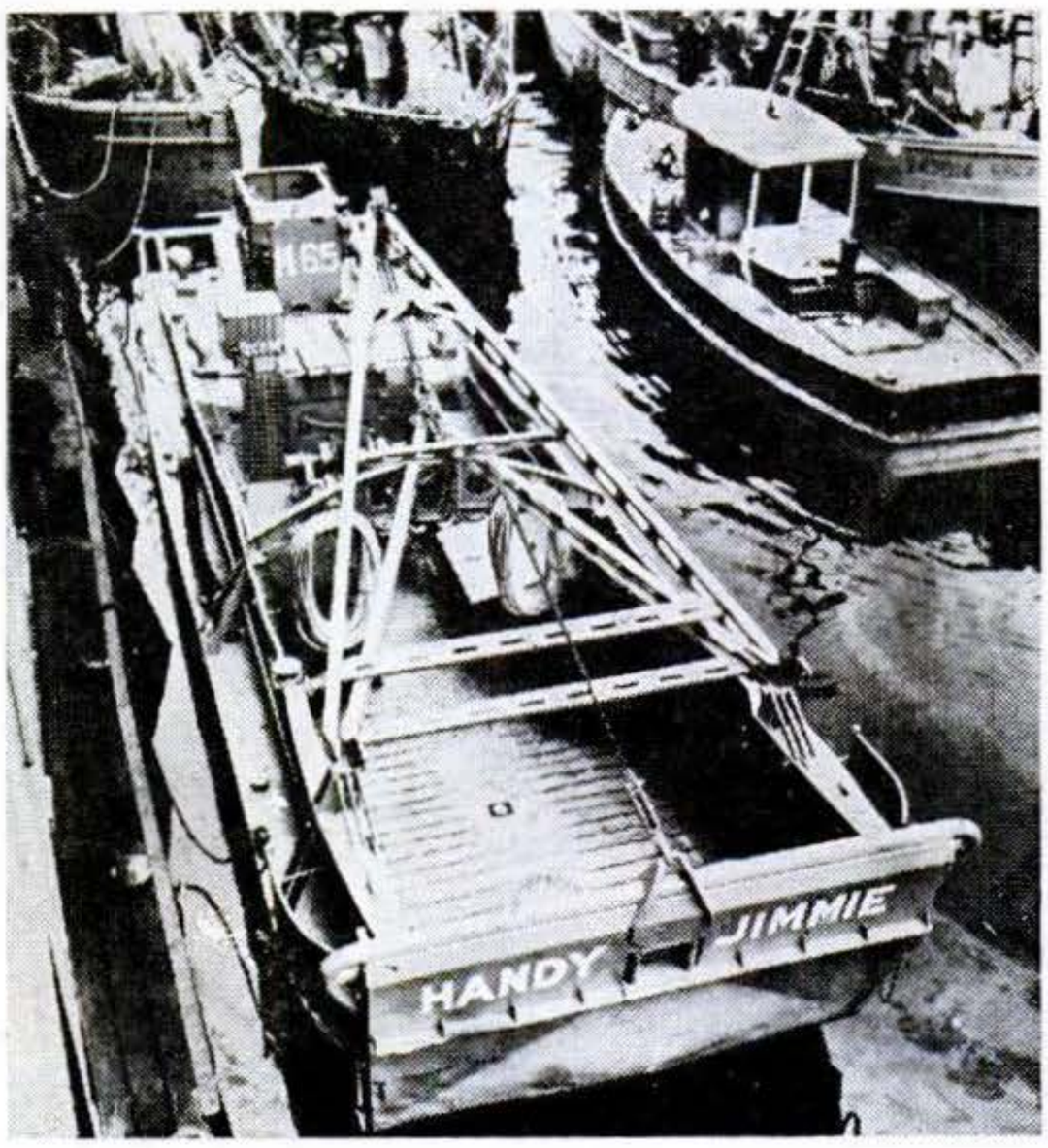

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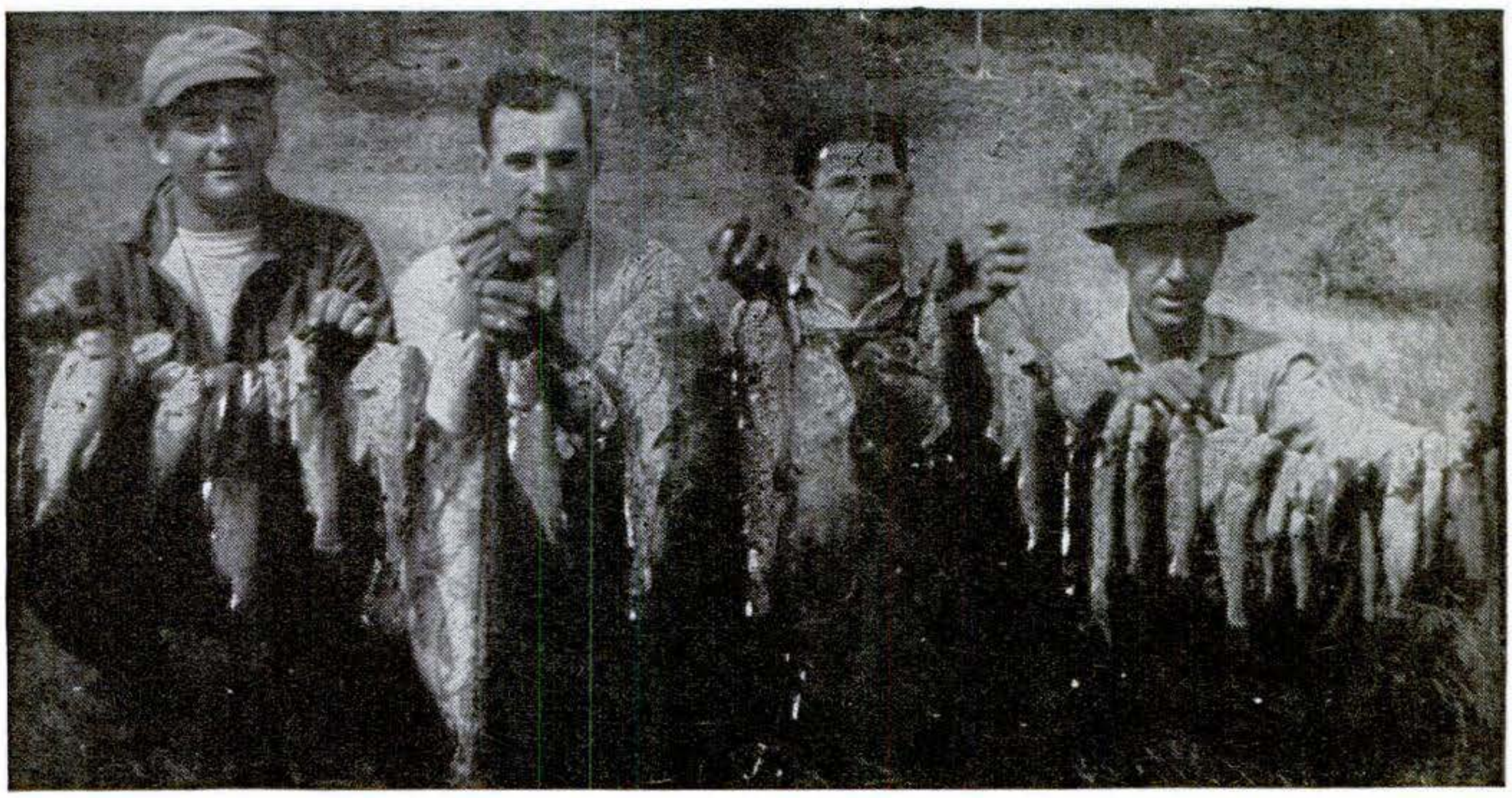

(Left to right) Wayne Ballard, M. L. Knight, Homer Patton and Buster Patton.

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Ed Cromer, member of the Fort Worth Anglers Club and editor of the *Fisherman,* sends us this photo of four of their members with catfish and bass. In his story he reports: "These boys say there's nothing to it. All you have to do is to go to Lake Texoma, fish in the Cedar Bayou and haul them in. The bass were caught on Hawaiian Wigglers."

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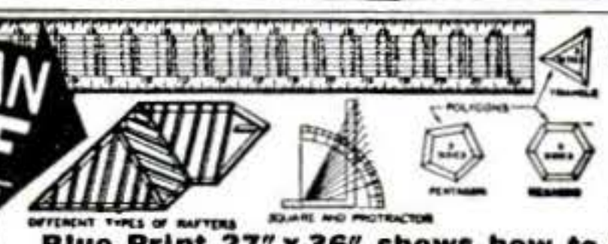

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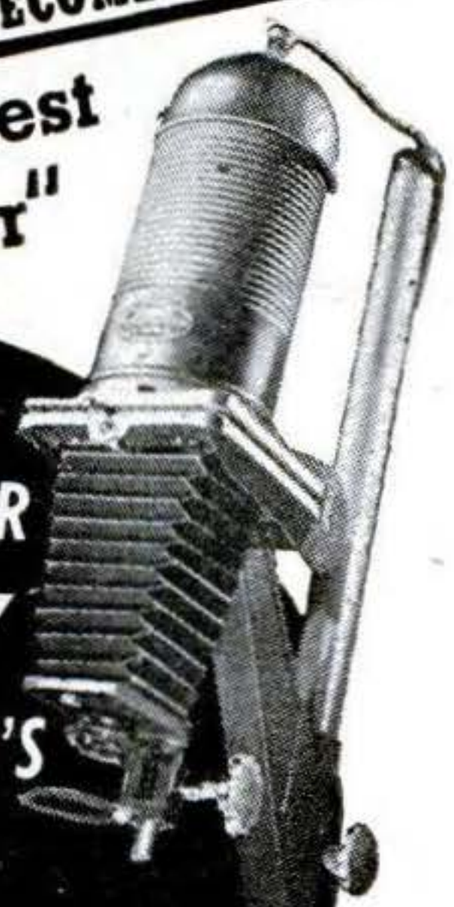

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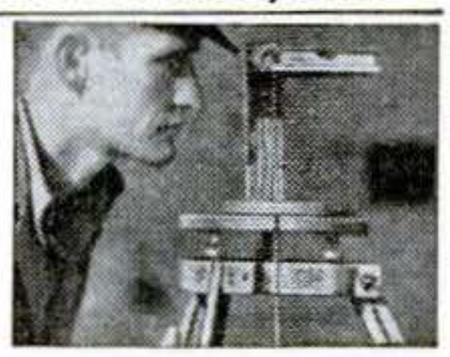

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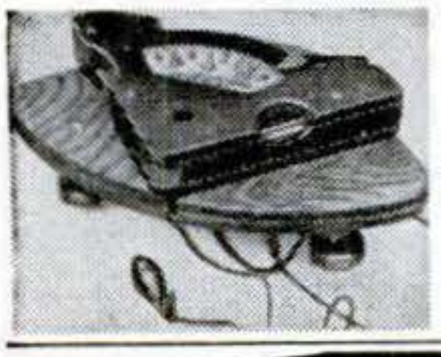

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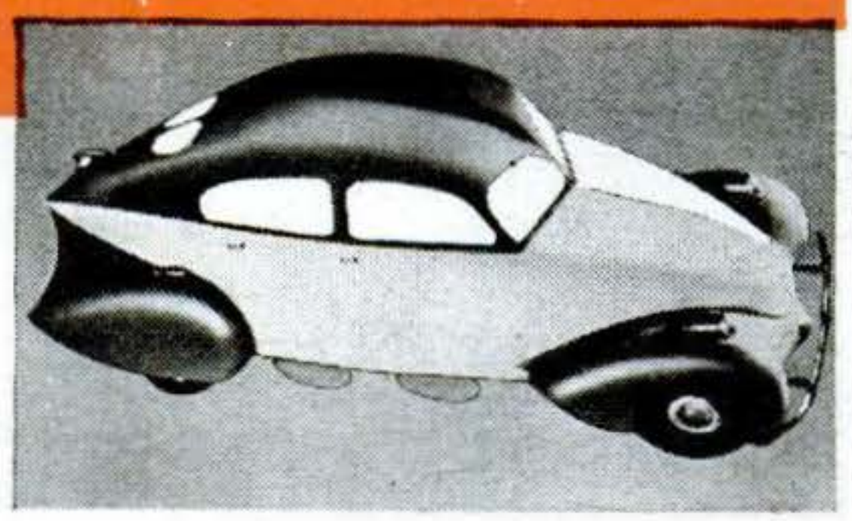

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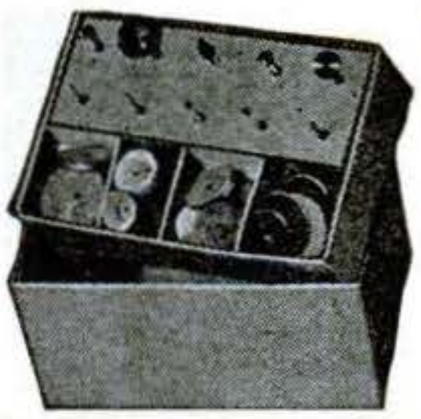

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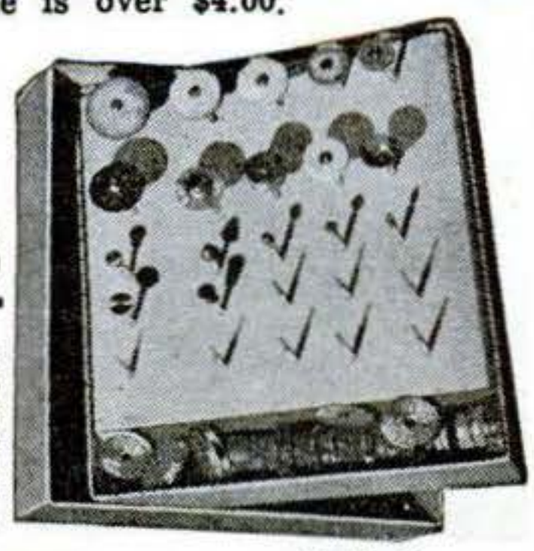

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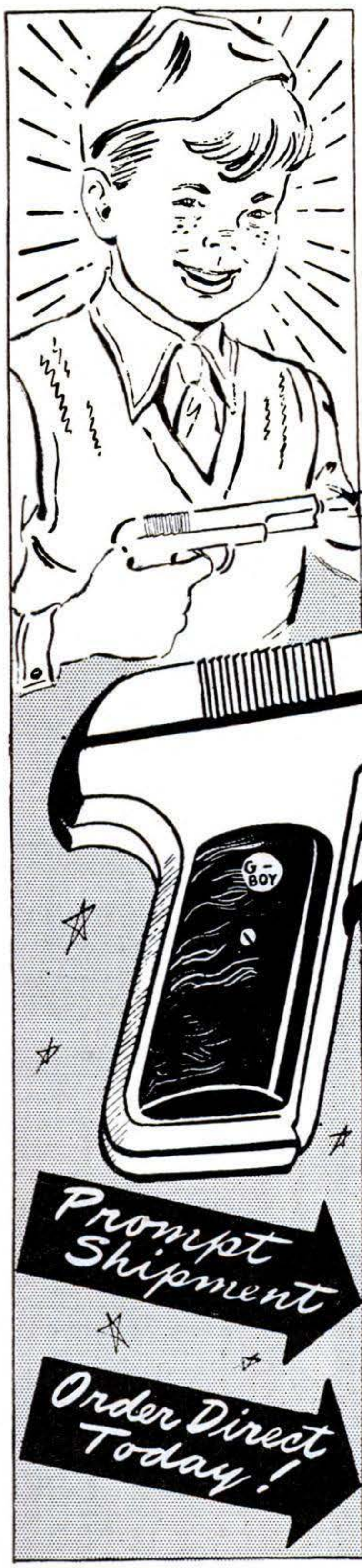

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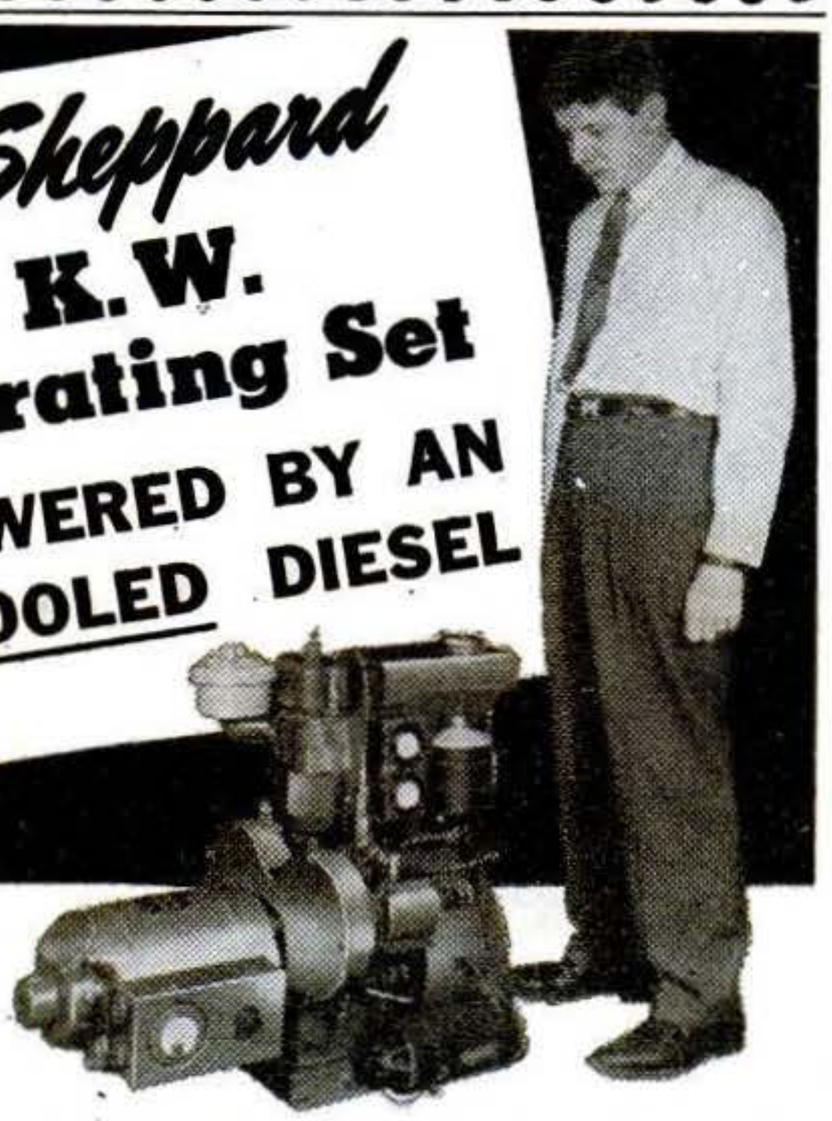

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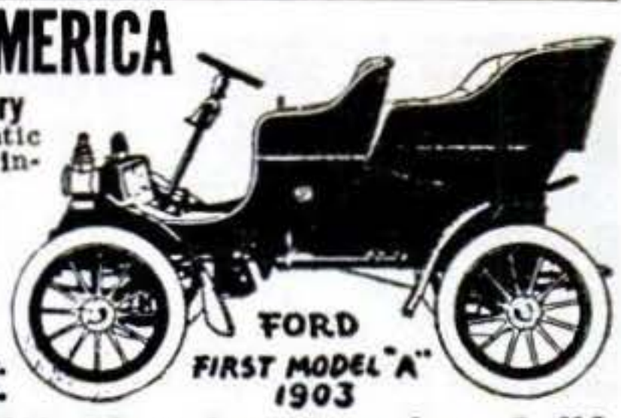

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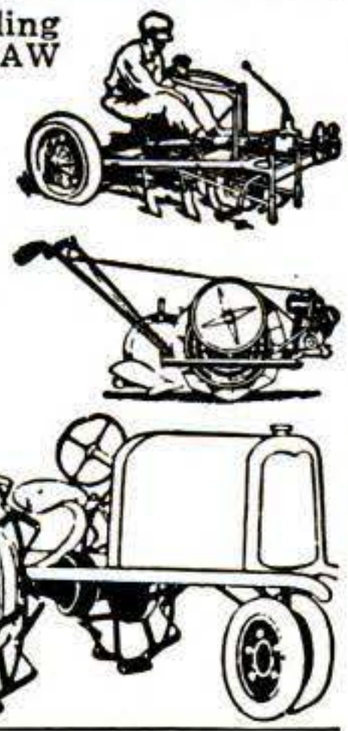

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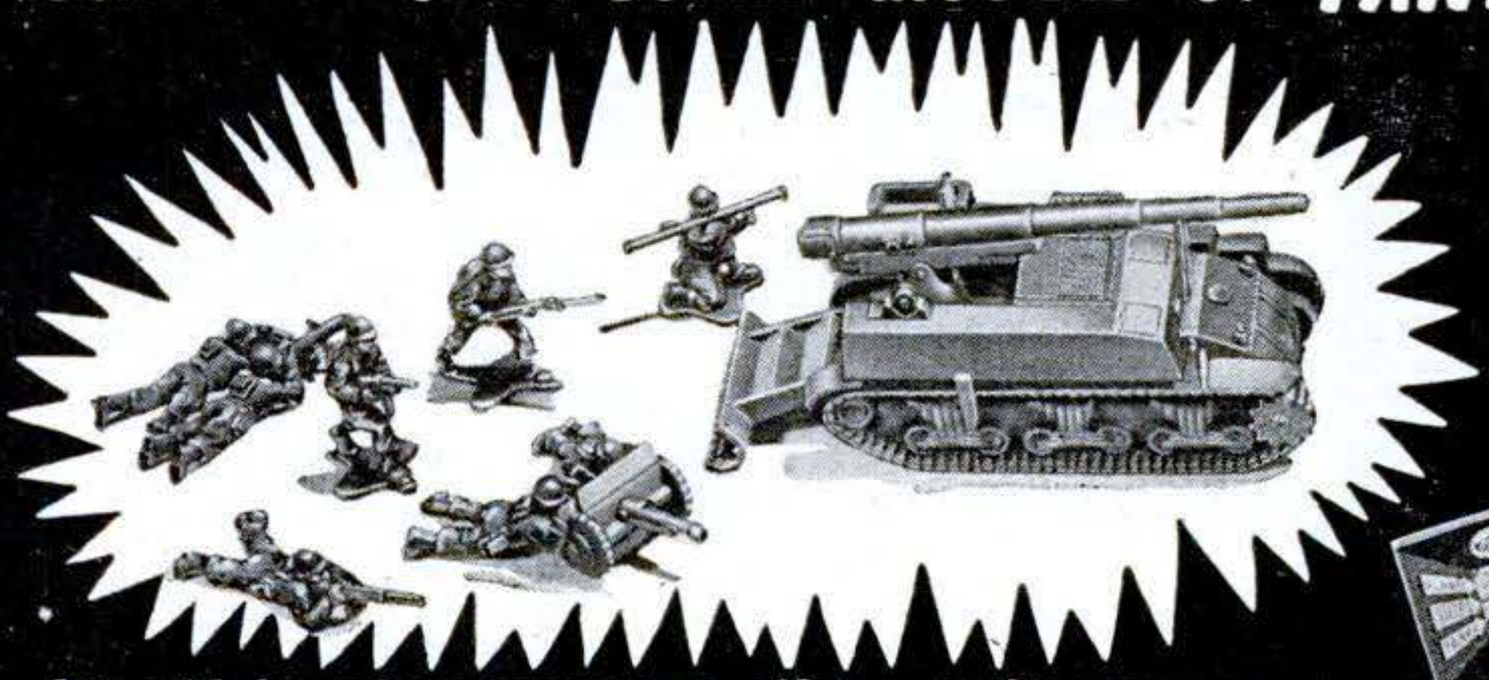

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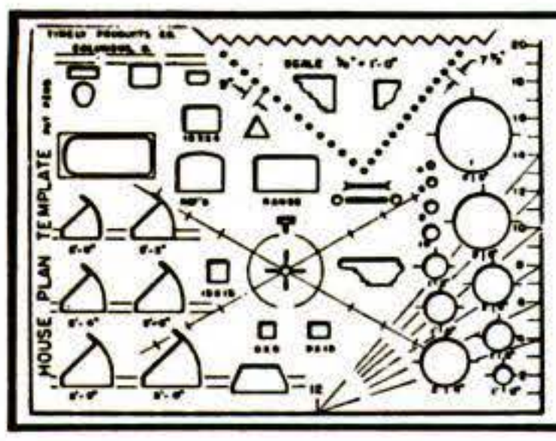

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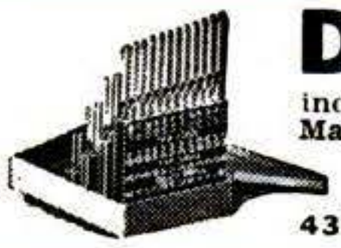

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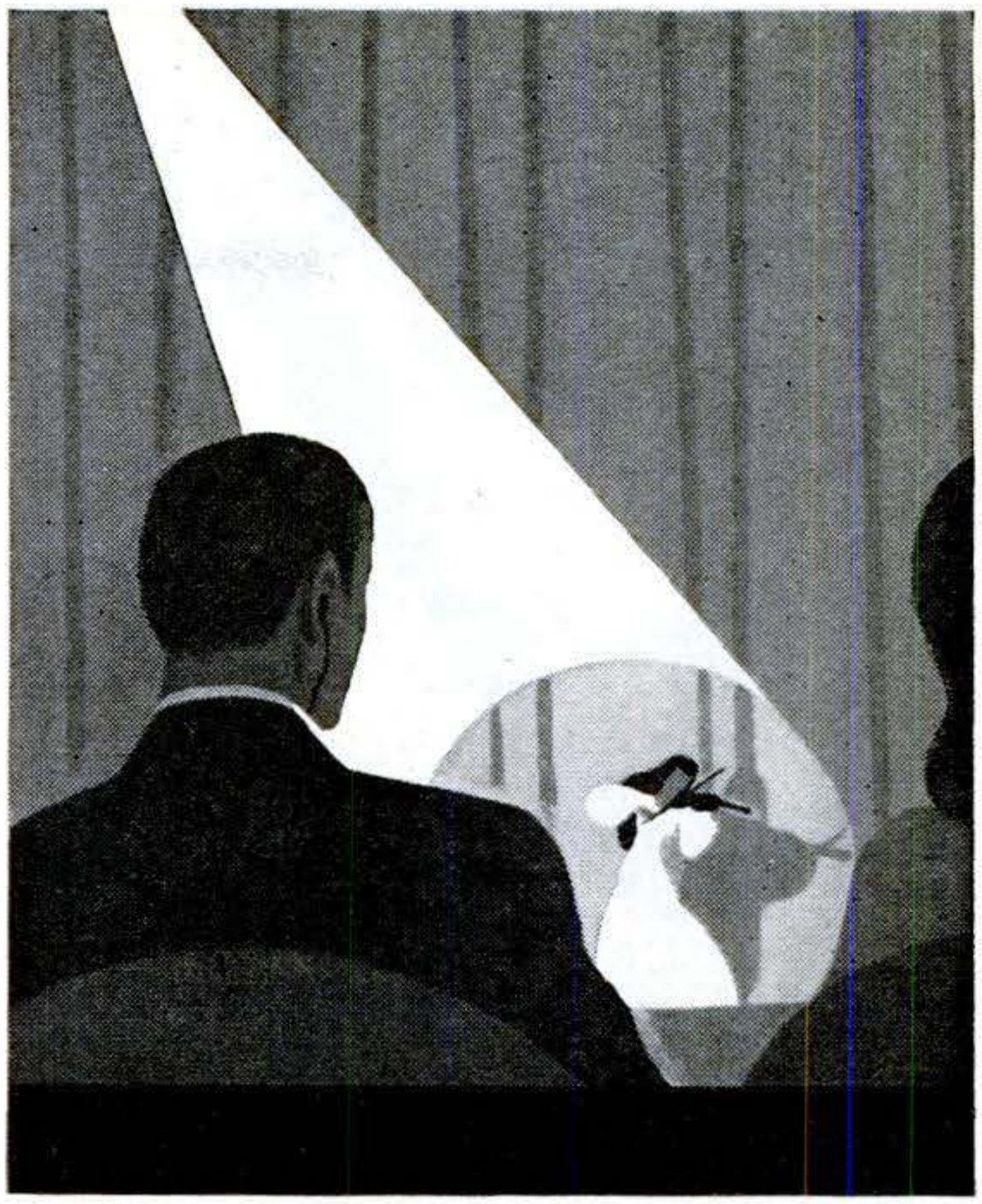

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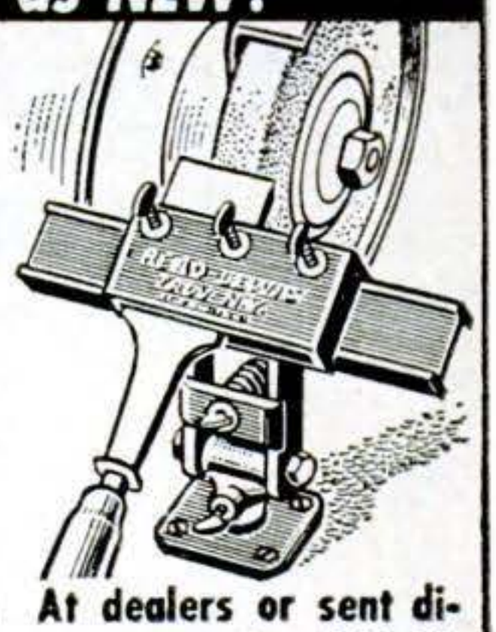

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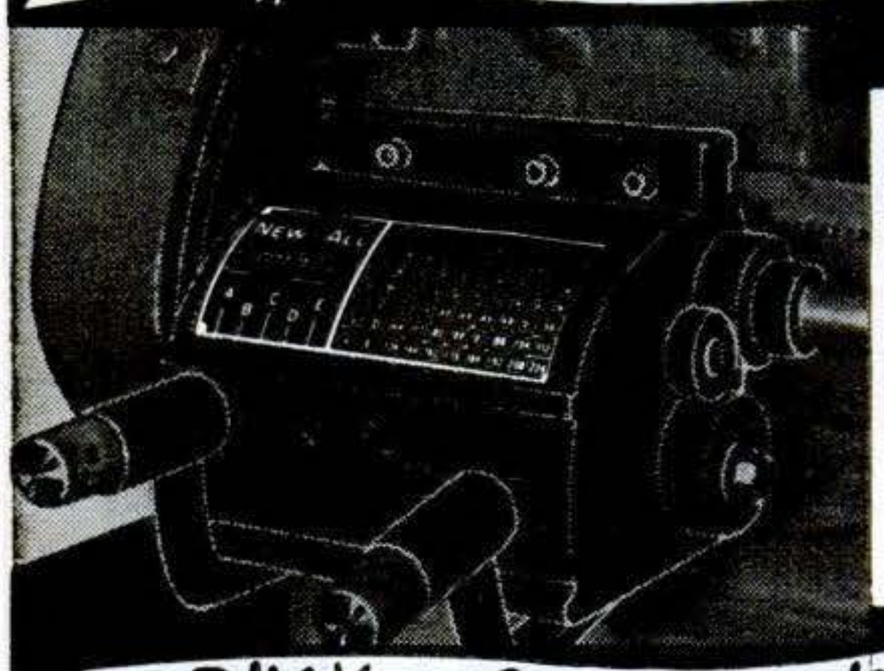

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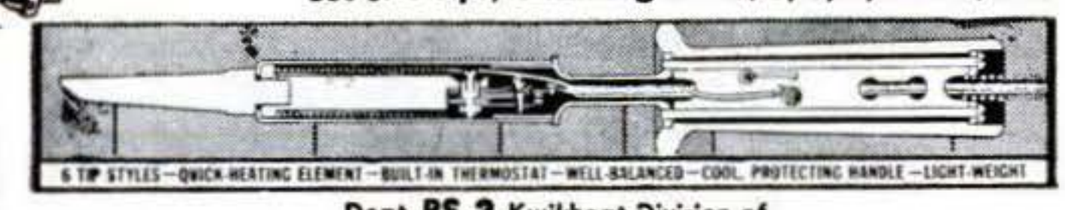

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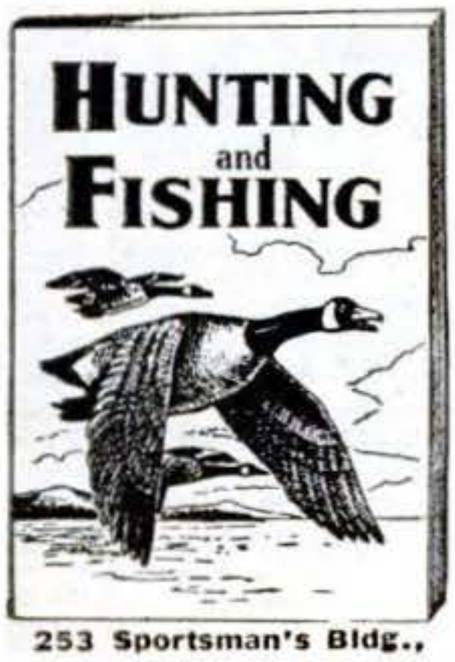

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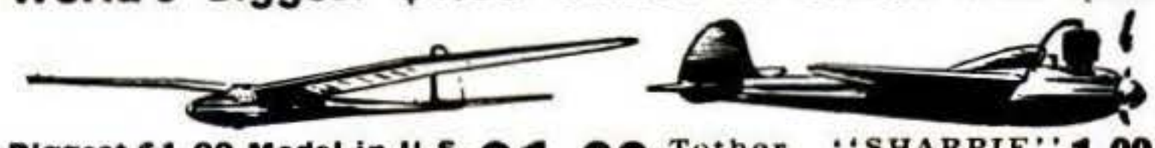

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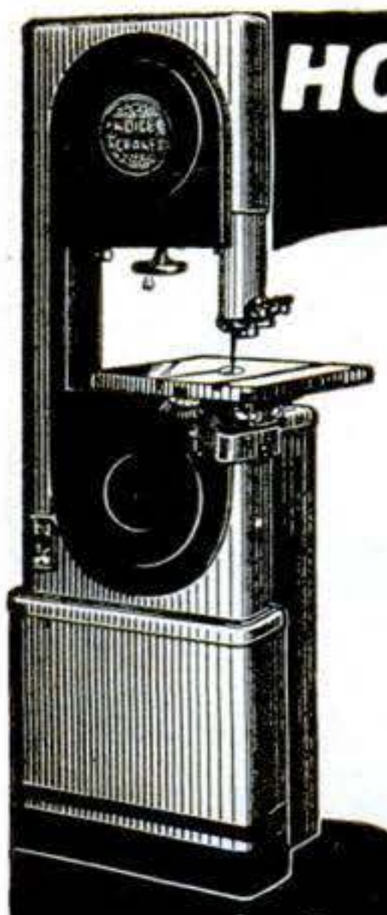

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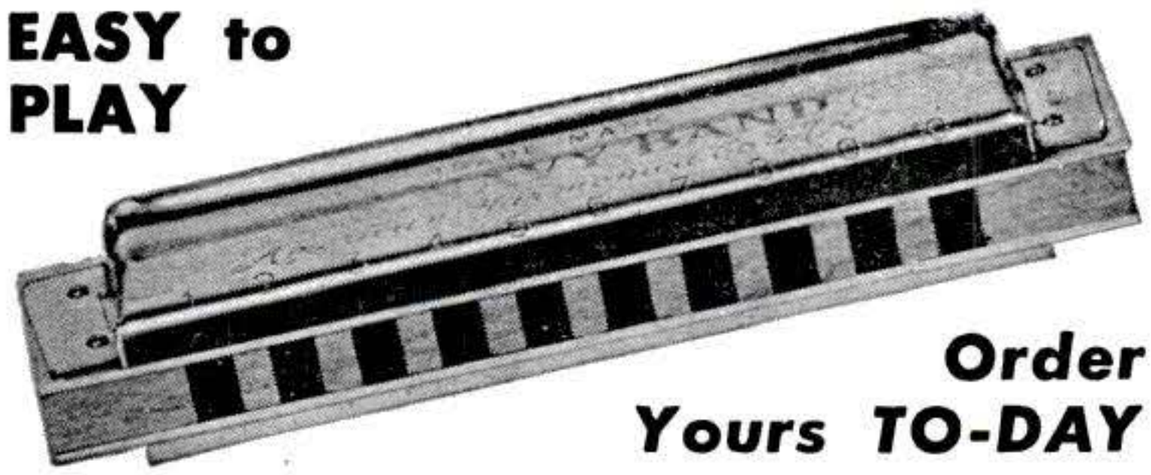

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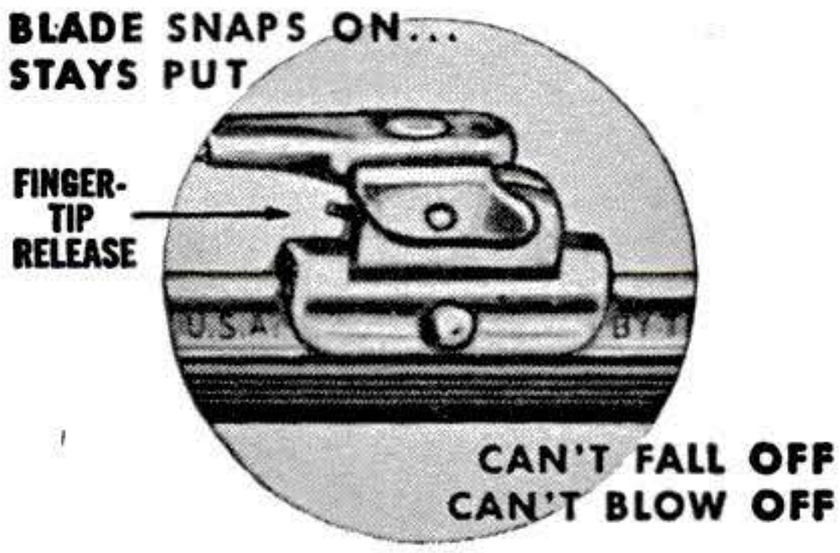

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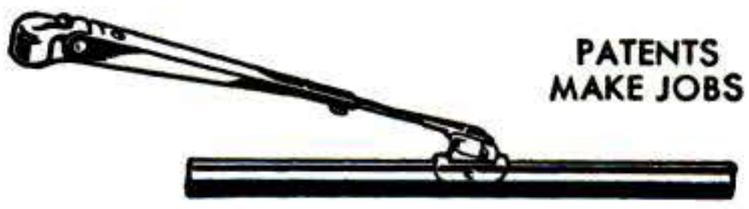

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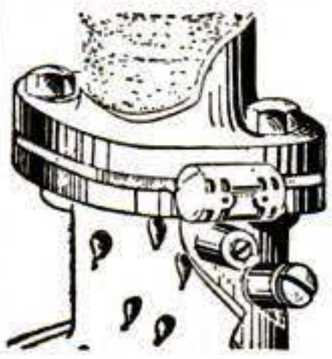

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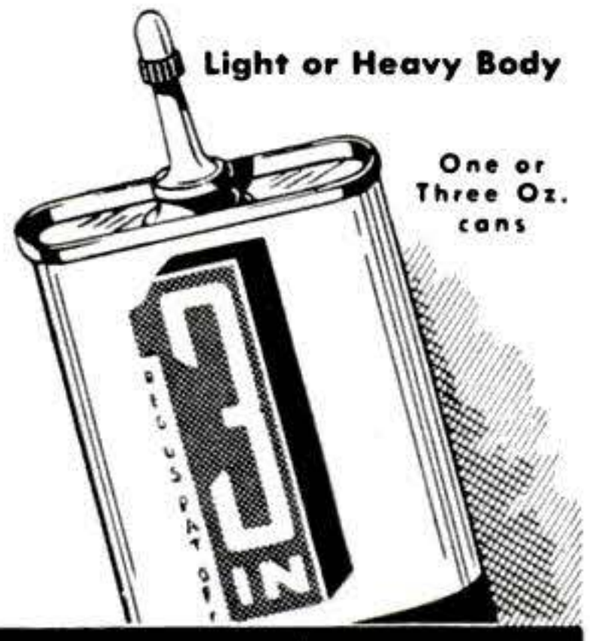

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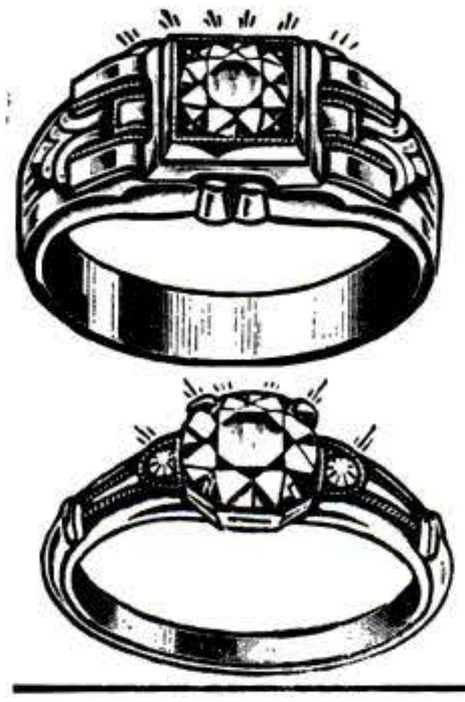

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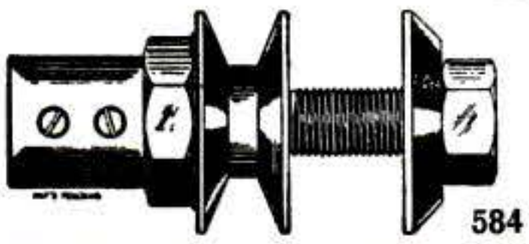

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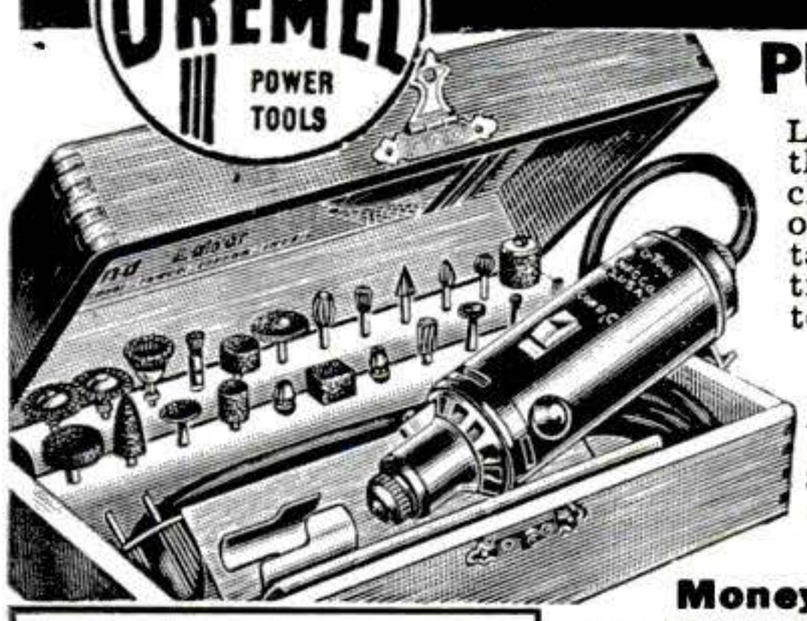

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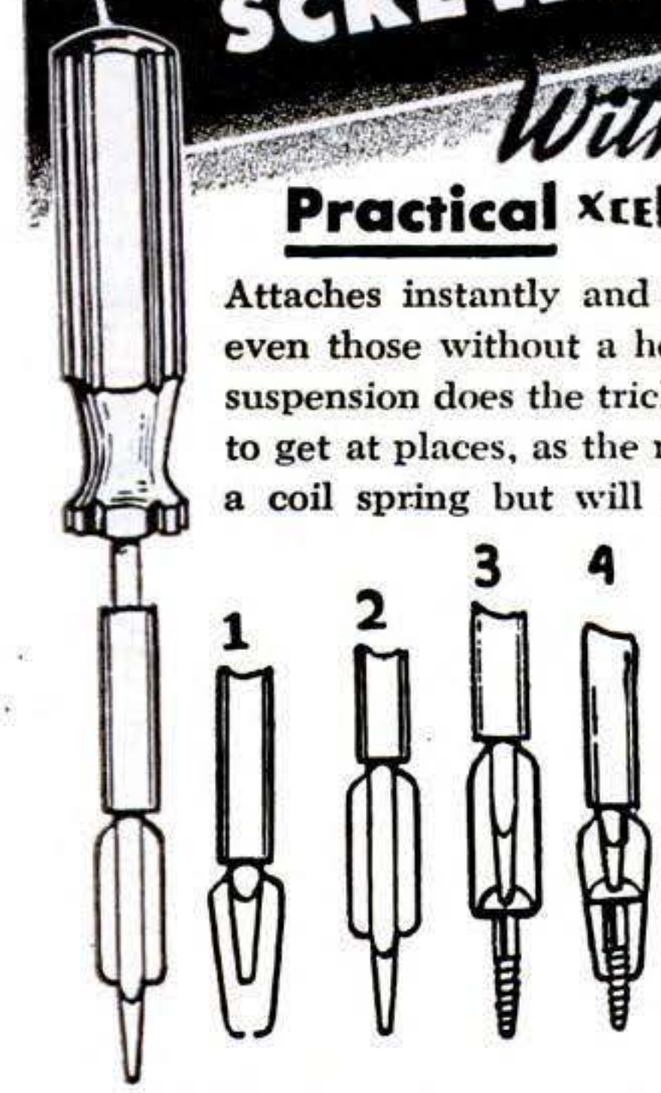

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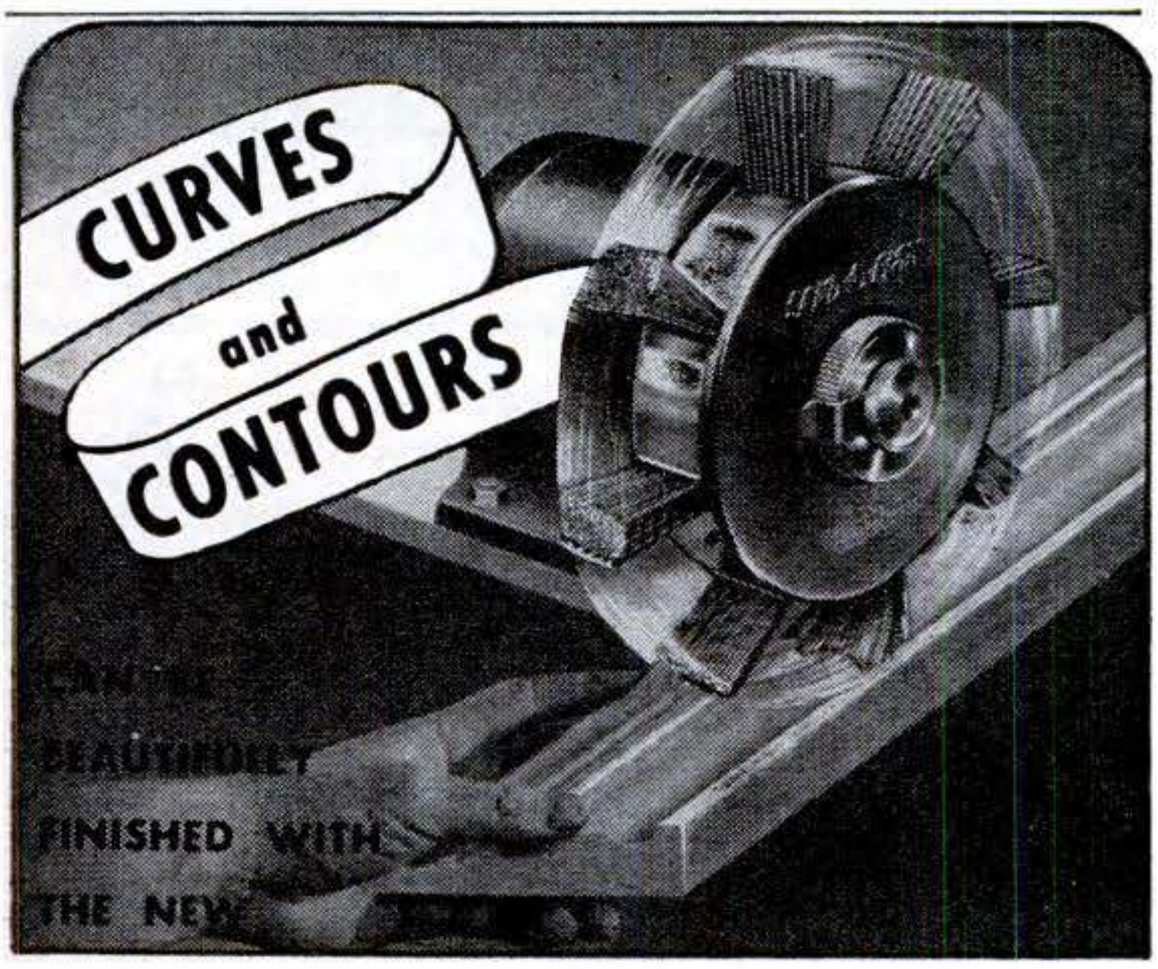

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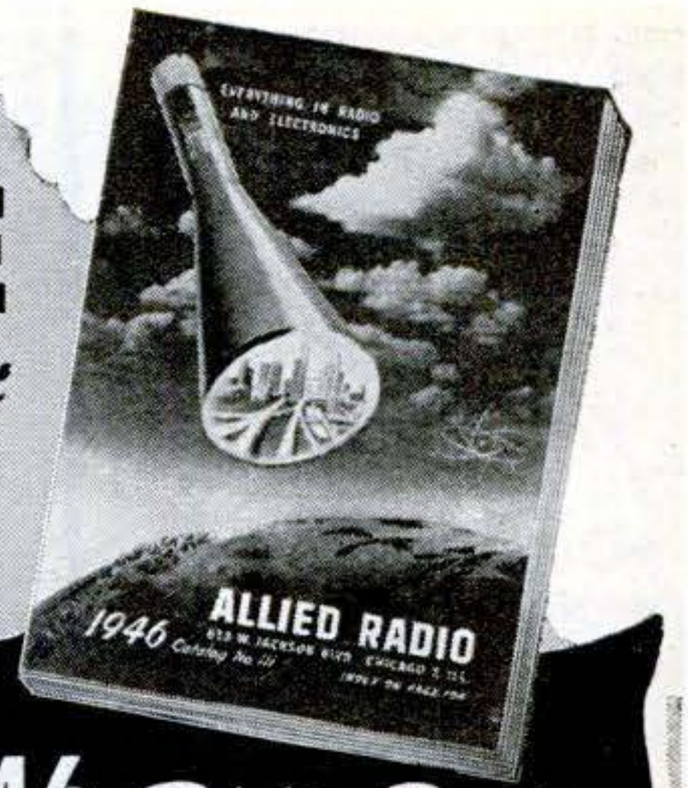

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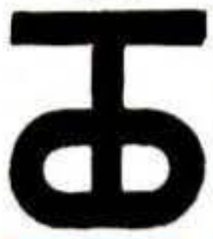

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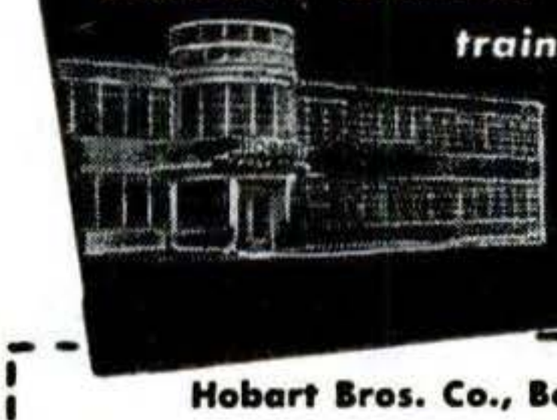

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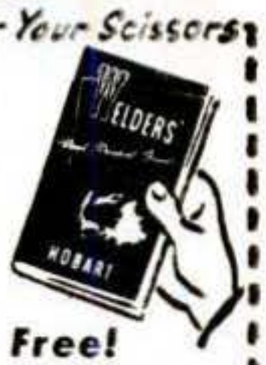

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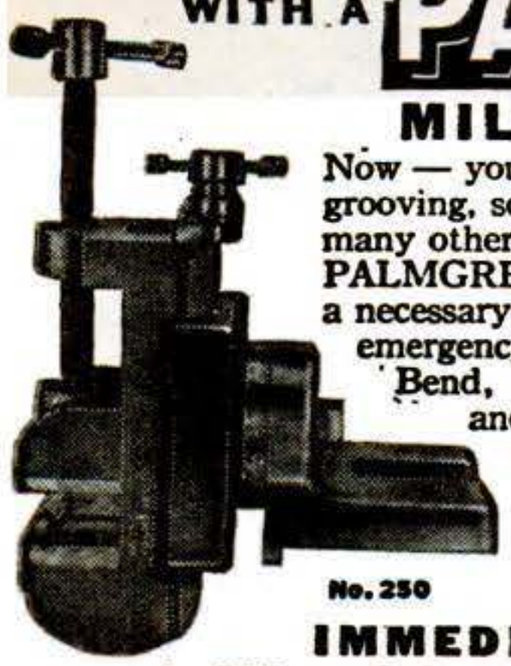

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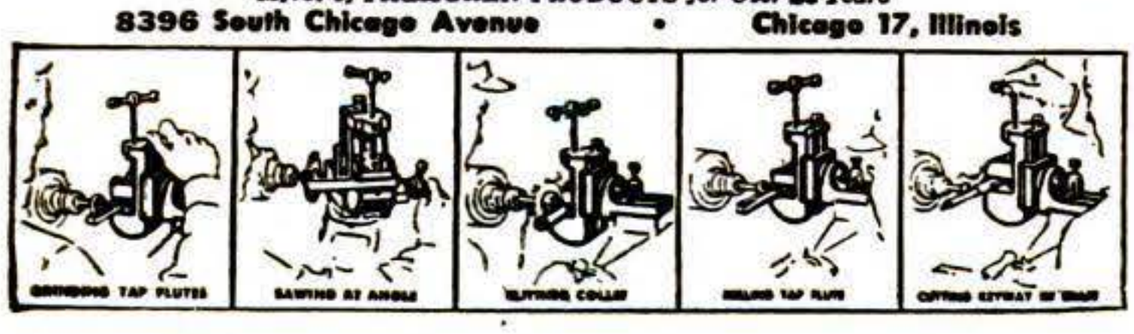

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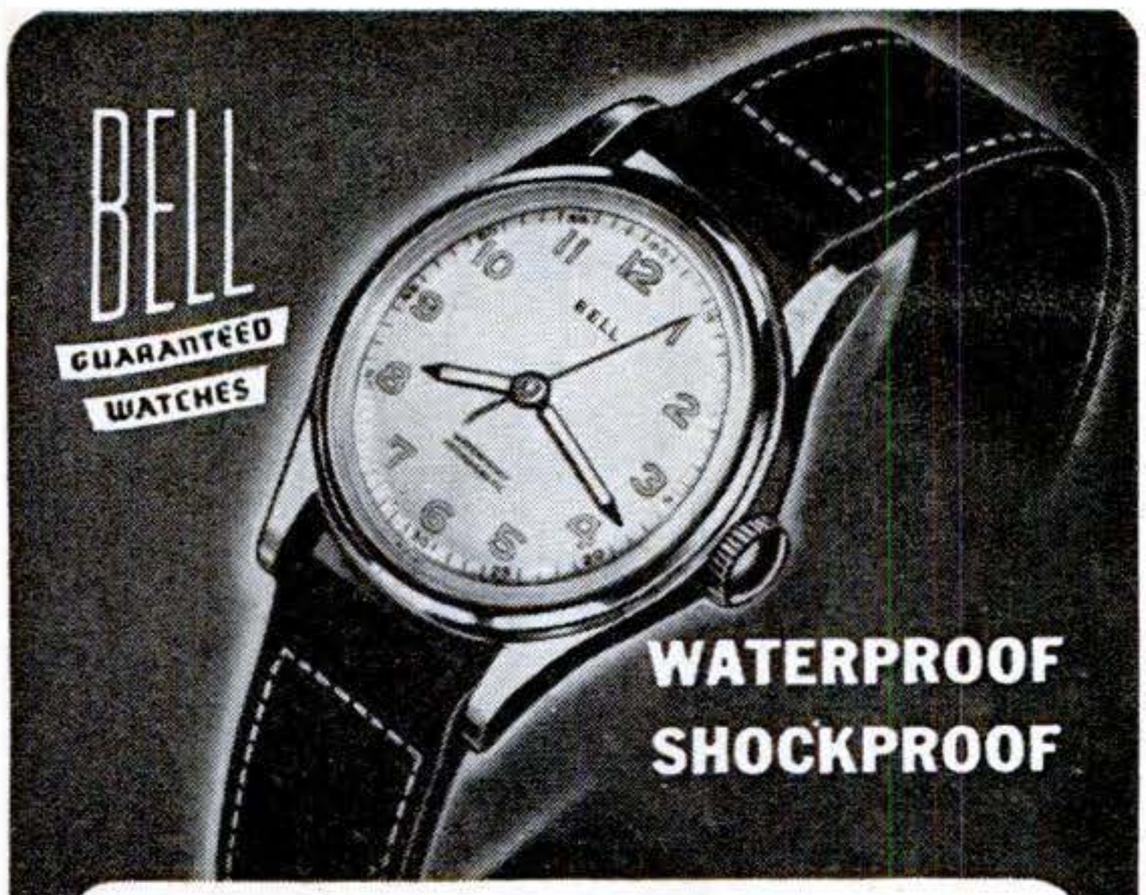

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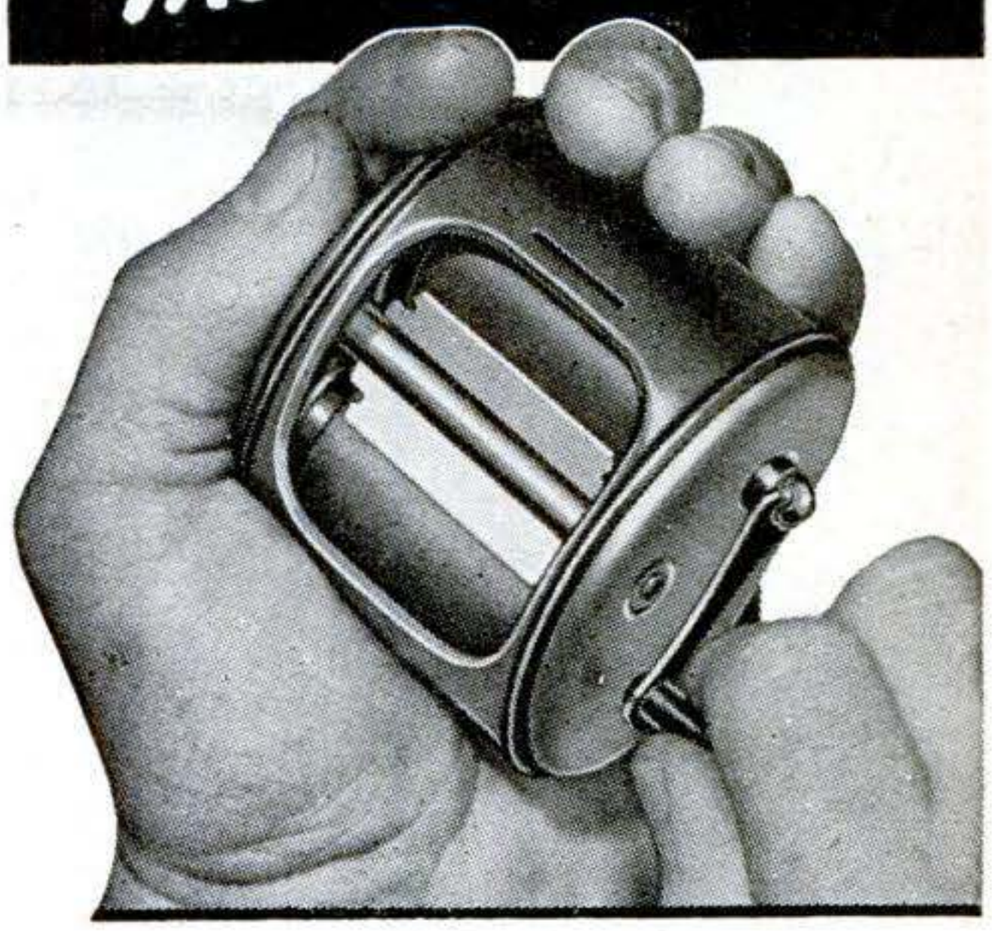

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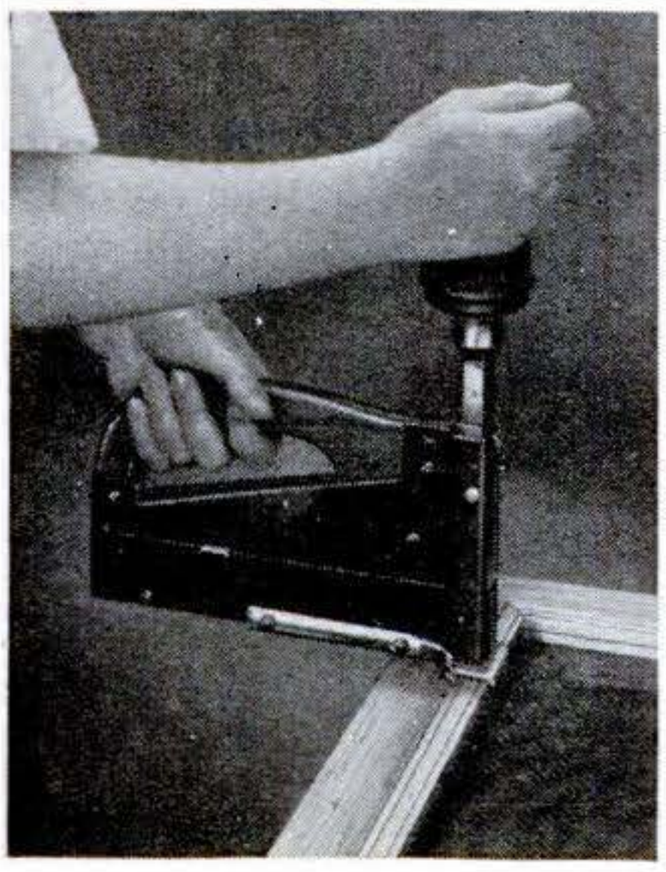

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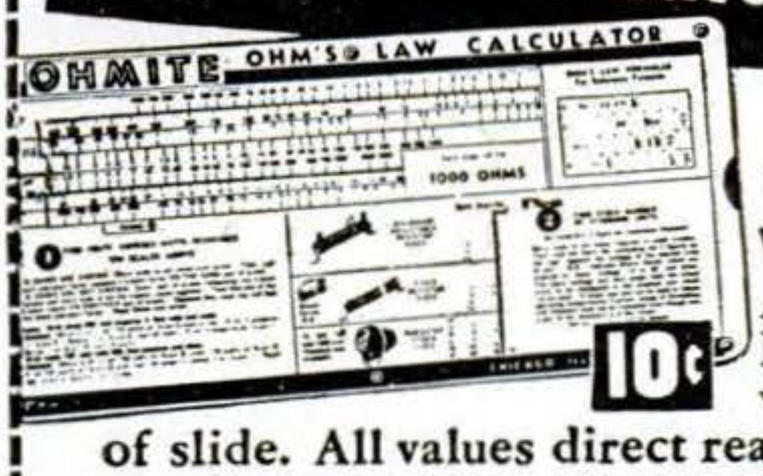

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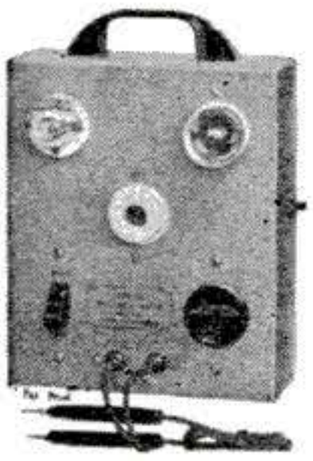

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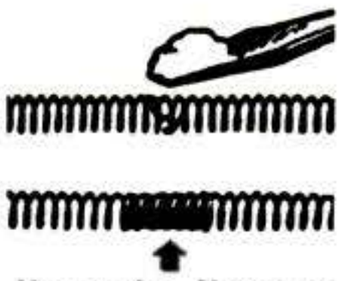

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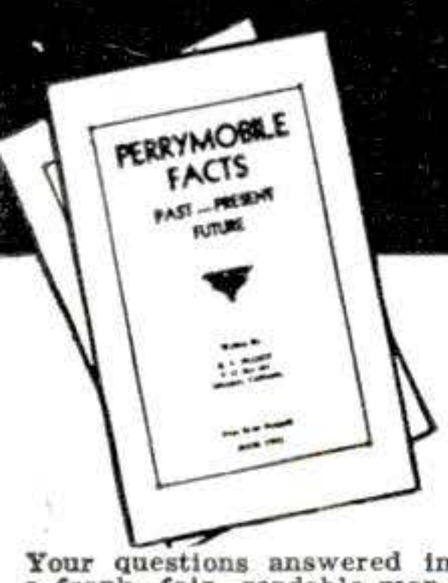

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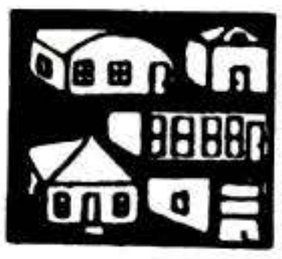

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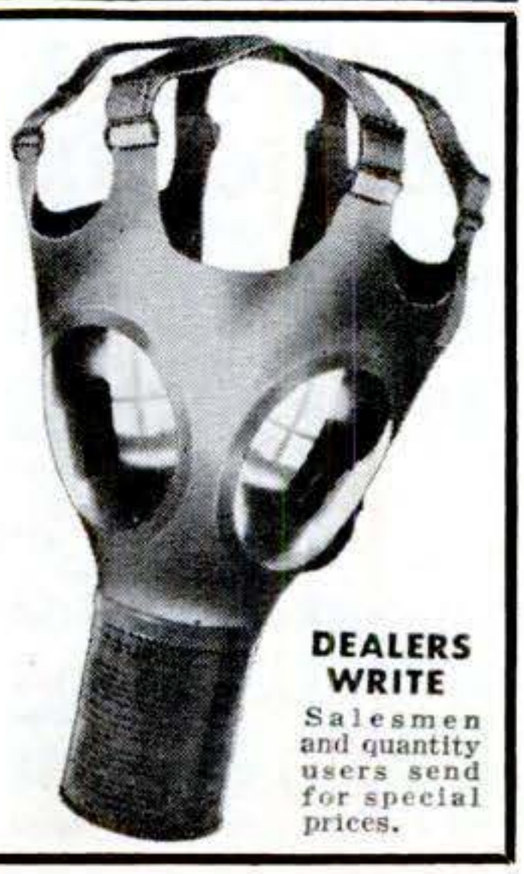

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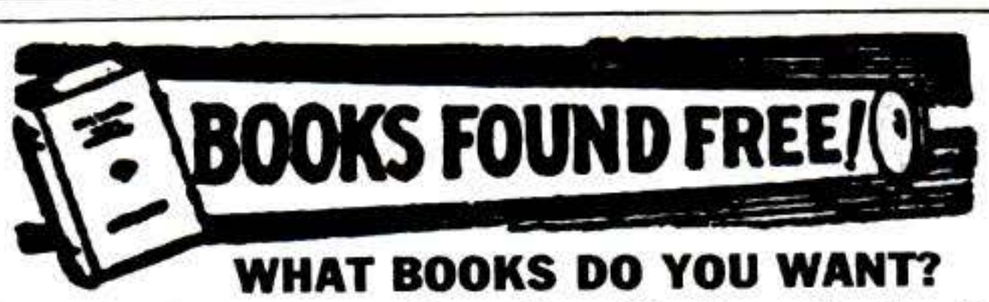

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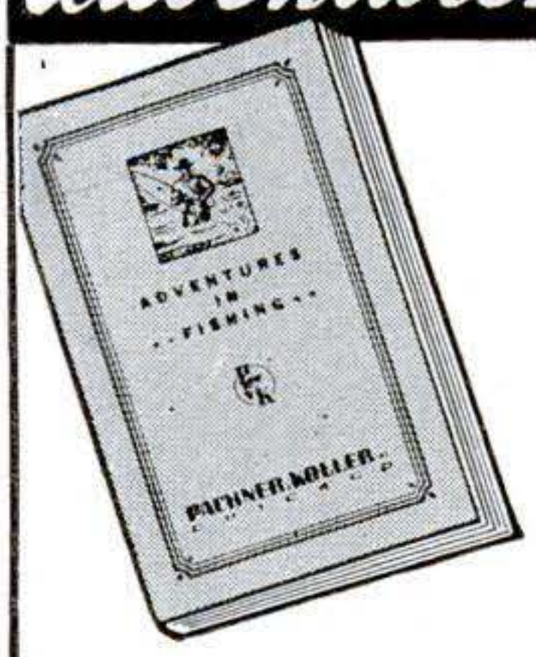

That's the title of a new P & K Booklet that is now on the press, and should be ready for distribution soon. Splendid articles by Cal Johnson, well known outdoor writer and fishing authority, on ***Boys and Fishin', The Sport of Bait Casting, Angling for Deep Water Bass, and Game Fish on The Fly-Rod*** make this booklet of real value to all fishermen, experts and amateurs alike.

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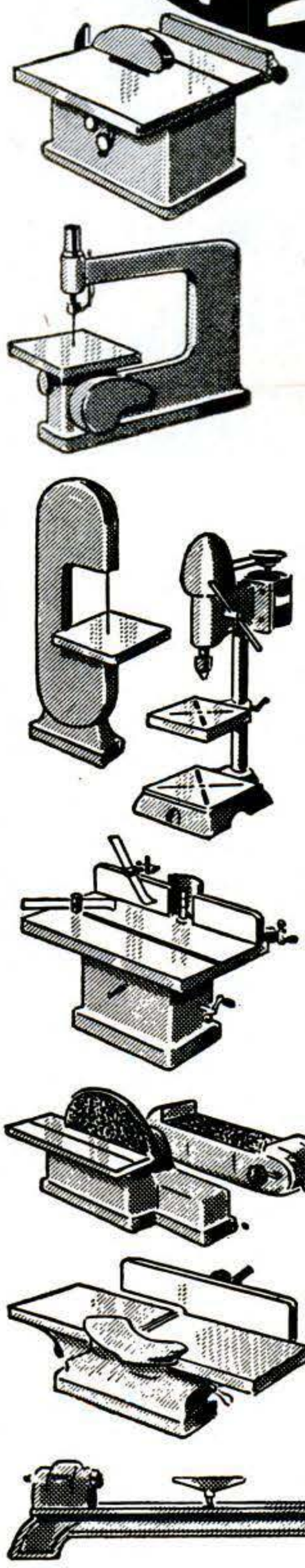

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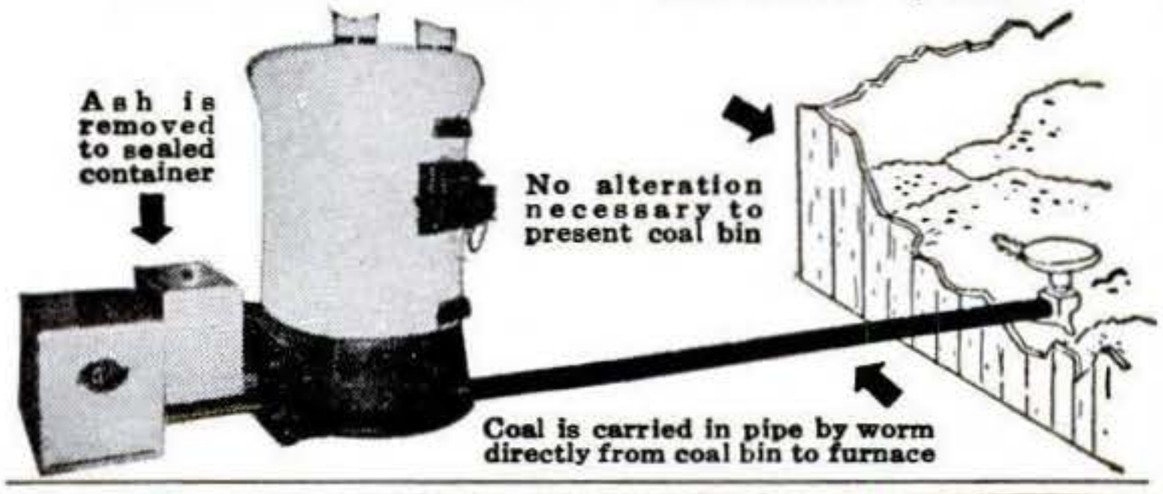

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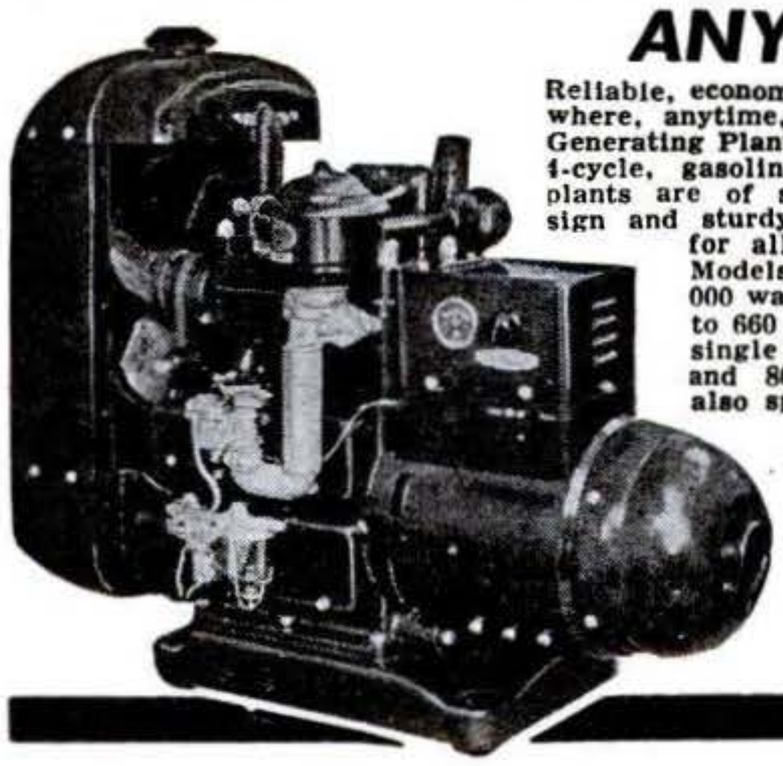

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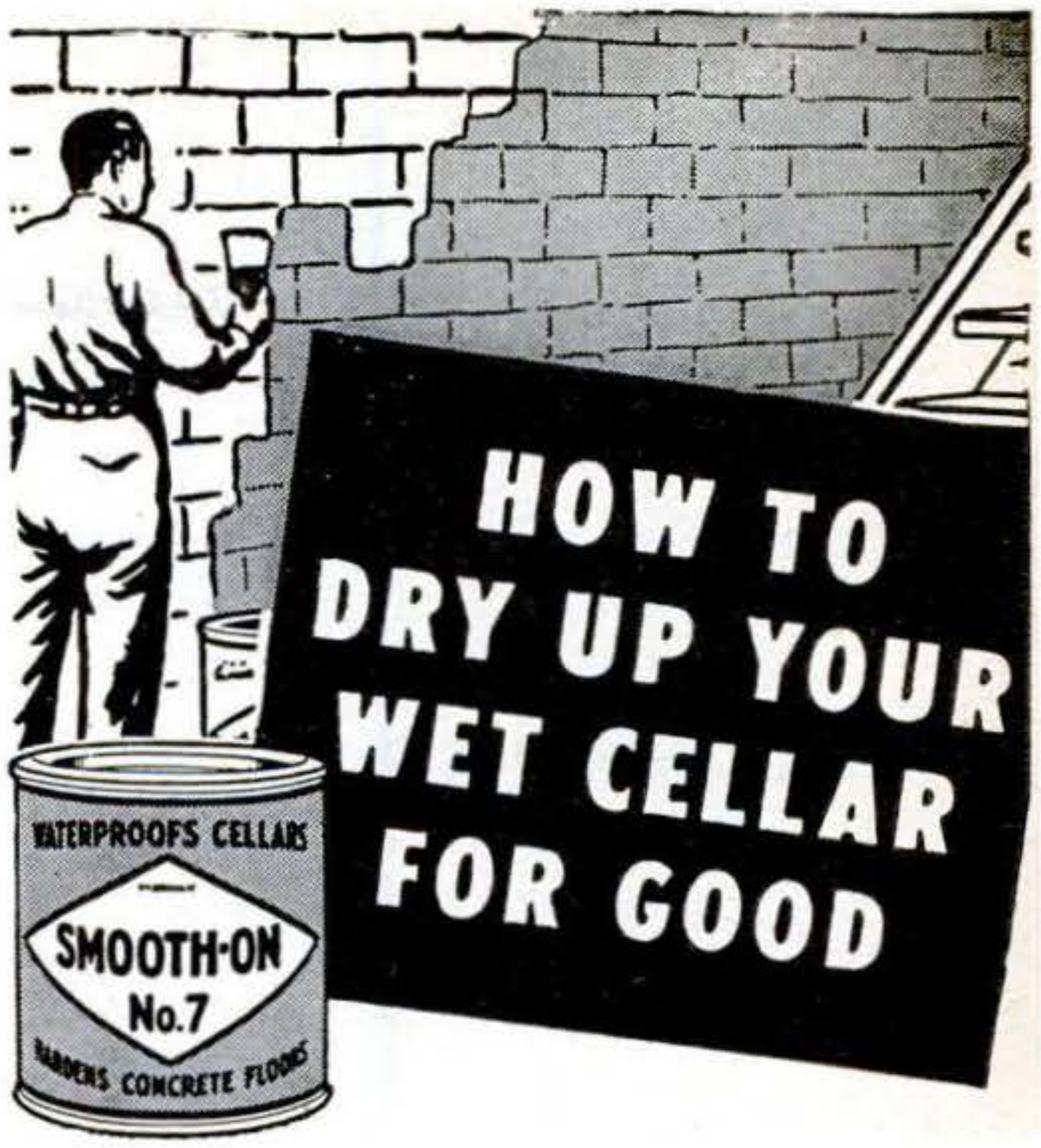

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TO: Reader
FROM: Editor

PHOTOGRAPHERS don't have to be crazy —but it helps!

MORRIS

Most notoriously nutty of all the cop-chasers, corpse-gapers, and other assorted journalists are the gentlemen of the Speed Graphic and flash gun, who make the pictures that are worth the thousand words. Any mere reporter will tell you that cameramen are crazy, since they fear neither fire nor sword nor Lady Astor.

Popular Science Monthly prints the pictures of many good photographers. We also have a couple of such characters on the staff who are always (a) in the darkroom, (b) in the studio, or (c) out on location.

William W. Morris has been doing these ABC's at PSM for six years now. Before that he was in charge of press photography at the New York World's Fair, bossing five or ten associate lunatics. Morris' first camera was a Sears-Roebuck box. He joined the Navy in 1915, made Chief Petty Officer in 1918, stayed in until 1923. But old Navy-hand Morris has been seasick on most of the trips he made to photograph the war at sea for PSM. An exception was his trip on the U.S.S. *Midway* from which came the exclusive photo-feature in this issue. Not even when he dangled between the great carrier and the destroyer *Fox* (see cut) did Bill get bilious.

Hubert Luckett is the younger, taller, Texan photographer on our staff. Lucky is 6 ft. 3½ in. and as lean as the ladder he rarely needs for a bird's-eye view. Son and grandson of machinists, Luckett also worked in a shop between years at the Engineering School of the University of Texas. From electrical engineering his interests turned to physics and optics, and then to photography, which has been his profession and hobby ever since. Lucky's understanding of optics is visible in the illustrations for "Sandless Glass Speeds Up New Lenses" in this issue. These charts of light at work are careful artist's renderings of lenses in action, posed with the actual glass by Luckett, the contrast then heightened by airbrushing.

LUCKETT

* * *

Just returned from the shakedown cruise of the U.S.S. *Franklin D. Roosevelt,* which shares with the *Midway* the title of world's largest warship, I can appreciate the tough job photographers had to portray the immensity of these huge carriers. During the war, as a correspondent for *Time,* I did two months of convoy escort and antisubmarine patrol on the U.S.S. *Mission Bay* — first of the *Casablanca* class of baby flat-tops to operate in the Atlantic. It was rugged duty for both the fliers and the ship's company. Cruising through some of the same waters two years later was quite different on the *F.D.R.*

I was also impressed, as always, by the professional photographers aboard. One of them was Irving ("Horrible") Smith, a caustic and competent newsreelman for Universal, who has seen a lot of combat stars go on the theater ribbons. Just before I left the ship at Cuba, Horrible Smith was trying to get permission from Captain Apollo Soucek to climb out the tall steel radio mast when it was swung down over the water. Smith just wanted a shot of the ship's bow cleaving the blue Caribbean.

Because of their jobs, maybe photographers are better off at least a little crazy. But their courage to concentrate on their cameras when most of us would shut our eyes has given all of us that sense of realism so important in a day when the realistic approach is vital.

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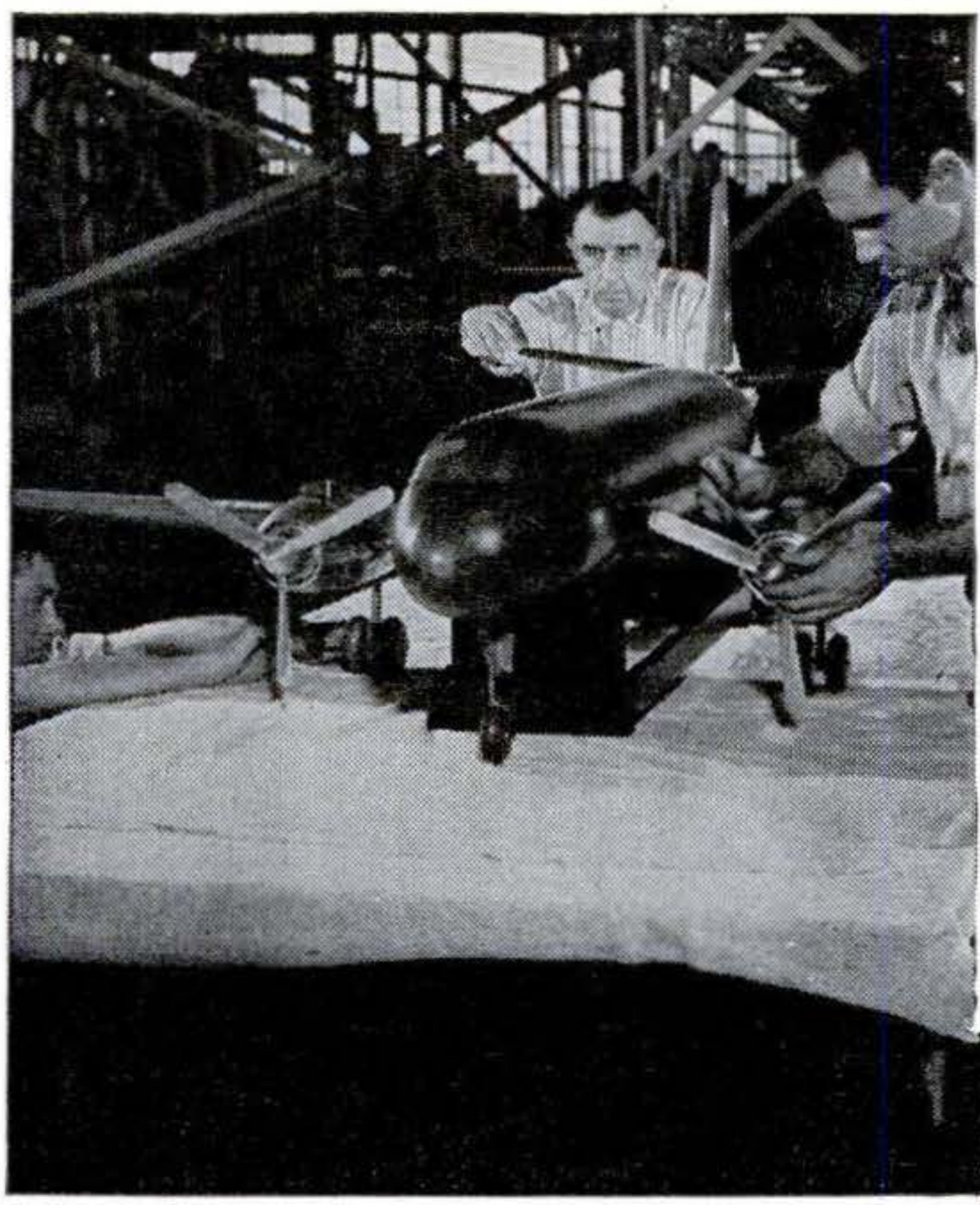

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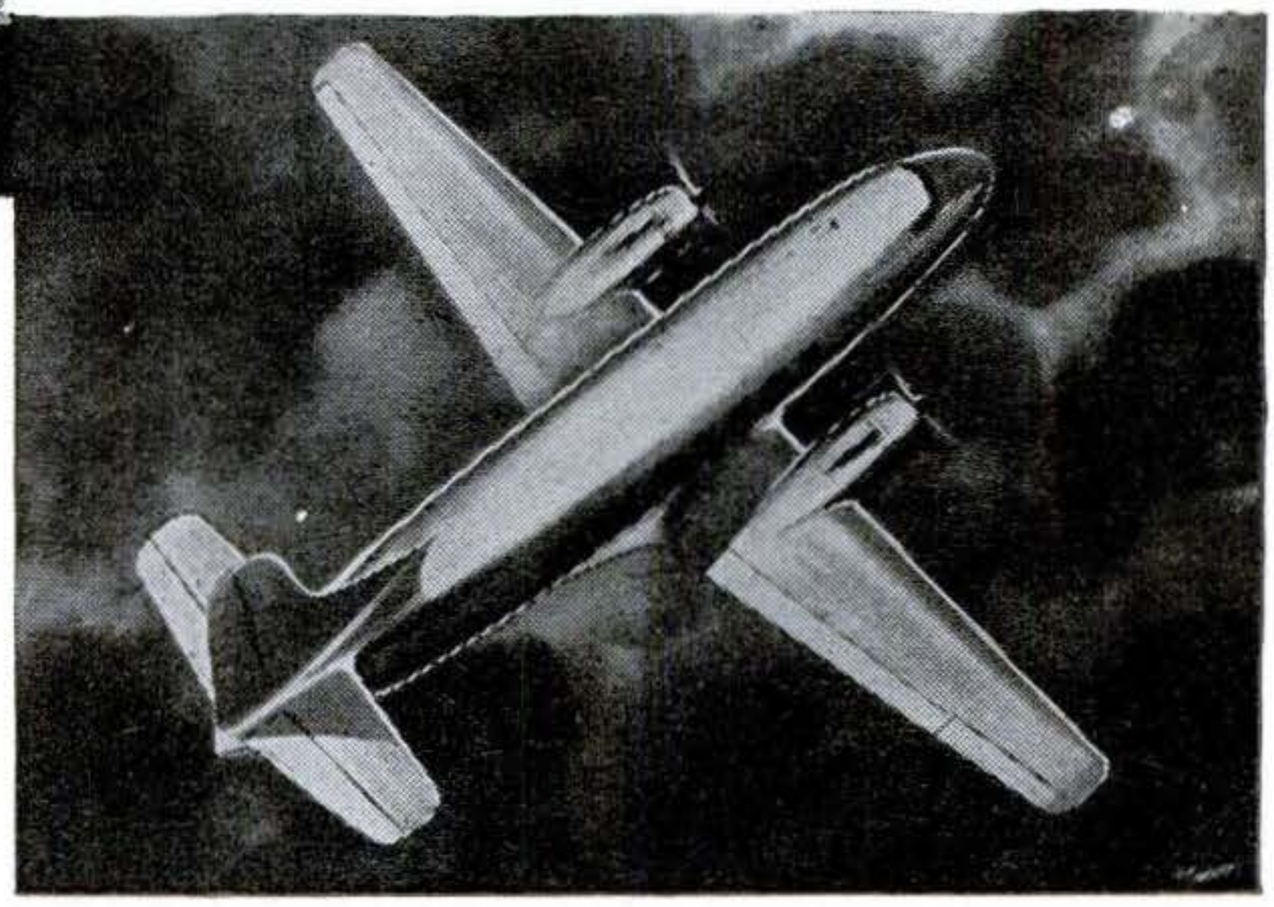

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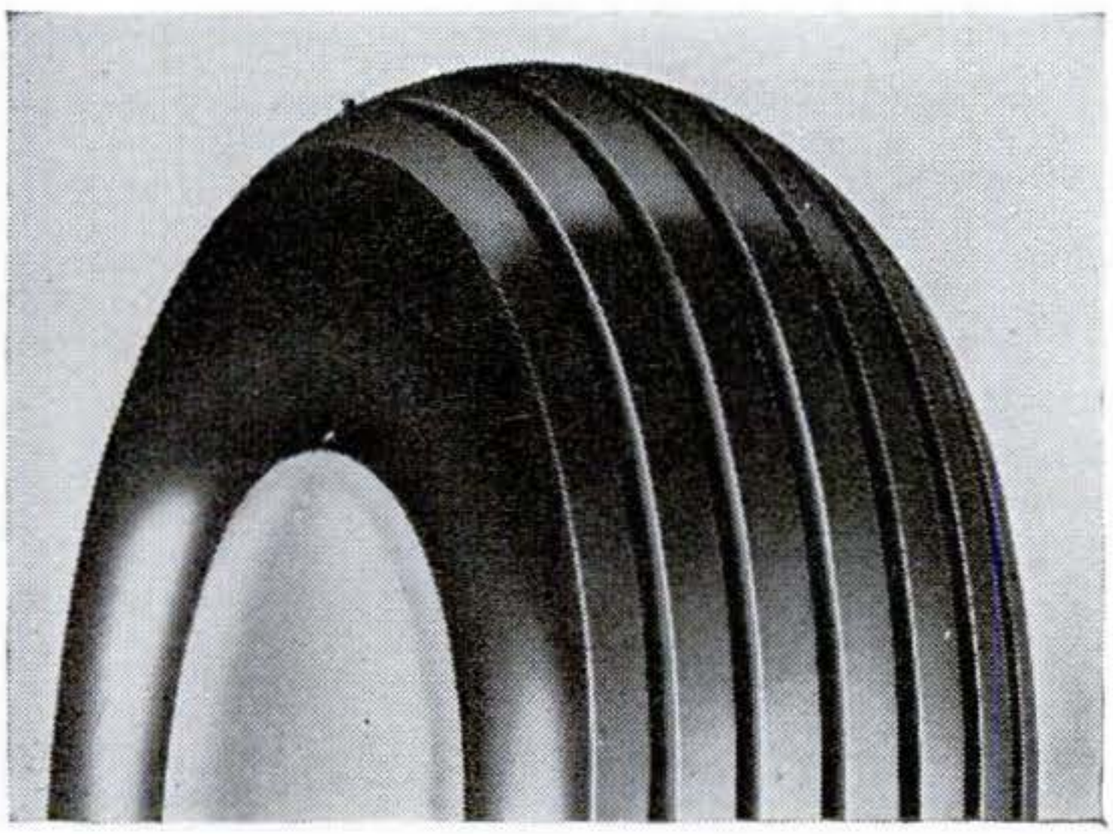

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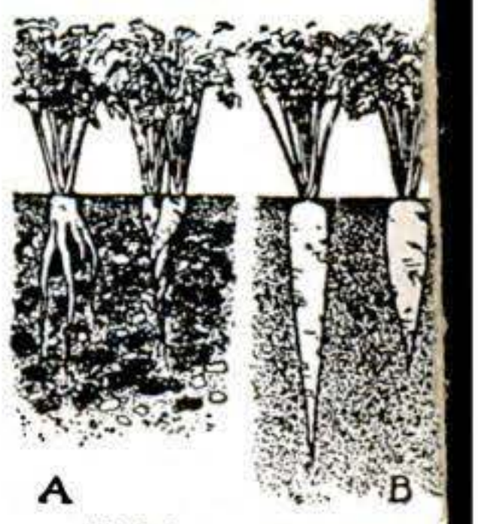

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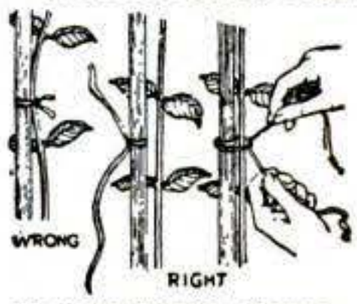

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